



**GOVERNMENT OF INDIA,  
MINISTRY OF WORKS, MINES, AND POWER.**



**Report of the Ad-hoc Committee in  
connection with the Investigations  
of the River-Valley Projects.**



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# REPORT OF THE AD-HOC COMMITTEE

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REPORT OF THE AD-HOC COMMITTEE, APPOINTED BY THE GOVERNMENT OF INDIA IN THE MINISTRY OF WORKS, MINES, AND POWER, IN CONNECTION WITH THE INVESTIGATIONS OF THE RIVER-VALLEY PROJECTS, PREPARED BY THE CENTRAL WATERPOWER, IRRIGATION, AND NAVIGATION COMMISSION.

“ We, the members of the Ad-hoc Committee met on 11th May 1948, and again on 18th May 1948, to examine the projects and estimates prepared by CWINC in connection with the Kosi, Narbada, Tapti, Sabarmati, C. P. and Berar rivers, Bastar State rivers, Assam Valley, and Coorg, in accordance with the terms of reference at Appendix I, page 9.

Messrs. Man Singh, *Member*, M. D. Mithal, *Director*, and G. N. Pandit and K. M. Bhatia, *Project Officers*, presented the proposals and explained the various features of the proposed developments.

They recast the relevant estimates in the light of some modifications proposed during the first day's meeting.

*Item I of the Terms of Reference.*

*I. What would you consider to be a reasonable cost of investigations of a project in relation to the overall capital cost of that project?*

As to the reasonable ratio which the cost of investigations of a project should bear to the overall cost of the project, in our opinion, no hard and fast figure can be laid down. Generally speaking, the cost of preliminary investigations will not be less than one per cent of the overall capital cost. It may go up as high as five per cent, depending on the nature and features of the project.

1. KOSI PROJECT.

(APPENDIX II)

*Items II to VI of the Terms of Reference.*

*II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order?*

*III. Is the cost of investigations, provided in the above proposals, justified?*

*IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate?*

*V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects?*

The proposals in respect of investigations of the Kosi project, as put forward by CWINC, are in order.

The provision of Rs. 65 lakhs for investigations while adequate for the period in question appears to be on the low side for the completion of investigations. It will be more like one crore of rupees. The Kosi Dam, when constructed, will be the highest in the world—130' higher than the present highest dam, the Boulder Dam on the Colorado river in U. S. A. which is 726' above rock bottom. The dam site is situated in a highly seismic zone. The exploratory work and investigations at the site must therefore be very thoroughly done.

The proposed strength of engineering staff is adequate, for the present, but will have to be substantially increased if the recommendations under item VI are accepted.

The actual work of investigations at site was inspected by Dr. J. L. Savage and Mr. A. N. Khosla and is on sound lines. With more mechanisation in exploratory work and the operation of diamond drills—now that the Drill Foreman has joined—the work will be considerably accelerated.

*Item VI. In respect of the Kosi Project in particular, what are your views as to :*

- (a) *the desirability of obtaining from Disposals construction machinery to the extent of nearly 40 lacs in anticipation of the construction of barrage canals and dam; the expenditure to be treated as suspense in the first instance and charged to the project when the latter receives sanction: this course was followed in connection with the Hirakud Dam Project, and*
- (b) *the desirability of*
  - (i) *undertaking the construction of a meter-gauge railway line to the barrage and dam site (length nearly 40 miles), and*
  - (ii) *undertaking the construction of the barrage and canal systems in advance of the construction of the dam.*

In view of the recurring havoc caused by the vagaries and floods of the Kosi, and the need for growing more food for the country, the construction of this project is an urgent and vital necessity. This project with a potential development of 2 million k. ws. of power and 3 to 4 million acres of annual irrigation, offers immense scope of development in the industrial and agricultural fields. Therefore, any measures that are calculated to accelerate the work of investigations and, later, construction of this project, deserve to have the full support of the Government.

We fully endorse the proposals under (a), and (b) (i) and (b) (ii).

The exploratory work on the dam will take some time as also the trial load analysis which, it is hoped, the U.S. Bureau of Reclamation will undertake to do. In the meantime machinery and staff can be assembled and trained on the construction of the Barrage and Canal systems and kept ready for the bigger construction programme for the dam. In this way large areas of land will be brought under irrigation in advance of the completion of the dam and the country prepared to receive the full benefits from the dam 3 to 4 years in advance, thus bridging the gap between completion of the project and development of its potential.

## 2. NARBADA VALLEY PROJECTS.

### (APPENDIX IV)

#### *Items II to V of the Terms of Reference.*

*II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order?*

*III. Is the cost of investigations, provided in the above proposals, justified?*

*IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate?*

*V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects?*

The Narbada basin appears to hold great potential of development, and such development is likely to have far-reaching effect on the economic advancement of the country in general, and the basin in particular. It appears feasible to bring under irrigation 37,00,000 acres of cultivated and cultivable land in the basin, generate continuous power of over a million k. ws, and extend navigation from the river's outfall in the sea right up to and beyond Hoshangabad i.e., almost to the heart of the country. The principal works involved would be construction of about eight storage reservoirs, a number of barrages and three systems of canals and some navigation locks. An overall estimate for investigation of the total plan has been prepared and amounts to Rs. 95,91,144. Estimates, prepared on the basis of expenditure from year to year, which were submitted to Government for sanction, were also placed before us. The amounts were Rs. 1,70,740 for 1947-48 and Rs. 25,91,000 for 1948-49. These have been examined by us in detail and appear to be in order.

In this connection Mr. Man Singh pointed out that the cost of topographical survey, provided in the estimates, could be brought down considerably if the contour-survey of the commanded-areas by the Survey of India Department could be reduced to just what was essential to enable the CWINC staff to pick up the channel alignments roughly, and thereafter do the detailed work themselves. This, he said, would have the added advantages, first, of reducing the work of the Survey of India who had already too heavy a programme for the staff they have, and secondly train up the CWINC staff for such work. He said, he had tried this in Bengal and the resulting work was quite accurate. Mr. Pandit said, he was working on this basis in the Tapti basin and calculated that the overall cost would be reduced to half. This, in our opinion, is a good suggestion and should be adopted wherever possible. Taking the resulting economy into account the total cost of investigations will come down to about Rs. 74 lakhs.

At this stage we were also apprised of the views of the Secretary, W. M. P., and the reactions of the Chairman, CWINC, regarding cutting short the programme of work on account of present day shortages of men and materials. The notes on the subject are appended to this report (Appendix III). We entirely agree with this view and suggest that it will be desirable to restrict the work in the first 2-3 years to only such projects as will give the maximum results in the shortest possible time. Judged from this criterion, we recommend that investigations be concentrated on the following :—

*Bargi Project.* The project envisages construction of 3 dams and a system of canals to command 18,00,000 acres. It is calculated that in addition it would be possible to generate 80,000 k. ws. of firm power. As most of the water will be used up for irrigation it might not be possible to make the navigational feature very attractive.

*Tawa Project.* This envisages construction of a dam on the tributary Tawa just above its outfall into the Narbada a few miles above Hoshangabad. A dam of 170 feet height will intercept the entire run off from a catchment of 2,340 square miles. An area of 11,00,000 acres would be commanded from the reservoir itself for irrigation. The power potential is likely to be 12,700 k. ws. (continuous).

*Punasa Project.* A dam of 237 feet height will intercept almost the entire residual run-off of the main river at this site. It is proposed to reserve a portion of the capacity for controlling the floods which occur frequently in the Broach district of Gajrat in Bombay Province. Taking this into account, the power potential of this project would be in the neighbourhood of 2,23,000 k. ws. continuous. The lake would be navigable right up to its upper end, very near Hoshangabad.

*Barrage and canal system for the Broach District.* With the regulated supplies available from the Punasa Project it would be possible to command the entire cultivated area of Broach district, measuring about 8,00,000 acres for perennial irrigation.

In addition to concentrated investigations on these projects we also recommend that the cost of collection of such essential data as discharge and silt observations at various important stations, meteorological, mineral, navigational and economic surveys and special tools and plant required should be provided for in the estimate for investigation of the projects on a basin-wide basis.

At our request fresh detailed estimates have been prepared to cover these investigations and these amount to Rs. 64,97,000. The cost will be spread over a period of three years, Rs. 26,97,000 in the first, Rs. 19,00,000 in the second and Rs. 19,00,000 in the third year.

The strength of engineering staff provided is adequate for the purpose in view.

While examining this project it was brought to our notice that there is a proposal to utilize the land to be commanded for irrigation by the Bargi and Tawa projects for resettling and rehabilitating refugees from Sind and Western

Pu njab. If, on this account, therefore, the investigations have to be speeded up, and construction has to be launched upon simultaneously, the staff for the se two projects will have to be considerably strengthened to suit the pace at which progress would be demanded.

### 3. TAPTI VALLEY PROJECTS.

#### (APPENDIX V)

##### *Items II to V of the Terms of Reference.*

*II. Are proposals in respect of each one of the above projects, as put forward by CWINC, in order?*

*III. Is the cost of investigations provided in the above proposals justified?*

*IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimate for the purpose, adequate?*

*V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects?*

Examination of the proposals reveal that potential of development in this basin is also fairly great, although it is not likely to be as attractive as in the case of the Narbada basin. The plan envisages construction of six dams and three barrages together with their canal systems. Of these the developments on Girna river are being investigated and undertaken by the Government of Bombay. The estimated cost for investigations of the rest of the project amounts to Rs. 42,25,034. The yearly estimates for the years 1947-48 and 1948-49, amounting to Rs. 2,60,540 and Rs. 20,56,000 respectively, were also placed before us. The provisions are in order. But the cost of surveys should be reduced by the CWINC doing most of the work, leaving only the essential part to be done by the Survey of India.

In this case also, we suggest that attention for the present be concentrated on the lowermost dam at Ukai and the Kakrapara barrage and canal system and only silt observations, and meteorologic l, mineral, navigation and economic surveys be carried out for the rest of the basin, for the present. At our request an estimate to cover this limited objective has been prepared and amounts to Rs. 19,95,500. This cost will be spread over a period of two years, i.e., Rs. 12,00,000 in the first year, and Rs. 7,95,500 in the second year. The provisions and the strength of the engineering staff for the purpose are adequate.

### 4. SABARMATI PROJECT.

#### (APPENDIX VI)

##### *Items II to V of the Terms of Reference.*

*II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order?*

*III. Is the cost of investigations provided in the above proposals justified?*

*IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate?*

*V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects?*

This river passes by the industrial town of Ahmedabad where, we are informed, the domestic water supply problem is acute. Authorities interested in the development of the basin are Bombay Province including Ahmedabad Municipality, Baroda State, Idar State and some States of Mahikanta, Sabar Kantha Agencies. Part of the catchment area lies in Udaipur State of the Rajputana Union. Projects for irrigation and improvement of domestic

water supplies have been prepared by various agencies from time to time. But owing to disagreement regarding water-rights and other matters nothing has matured so far. Recently, we are informed, in a conference of representatives of various interests held at Bombay, it was decided to entrust the development of the basin on a unified basis to the CWINC in the hope that better progress will be made in finalising and then executing the projects. Some engineering staff was offered to be provided by governments of Bombay and Baroda for manning the organisation to be set up for the investigations. Accordingly, an estimate for preliminary investigations amounting to Rs. 15,10,000 was prepared. This and the year to year estimates of Rs. 28,000 for the year 1947-48 and Rs. 5,20,000 for the year 1948-49 have been examined by us. No contour-levels are available in this basin. Maps of hilly portion merely show the form lines. It has, therefore, not been possible to indicate precisely the development that might be possible. Some preliminary investigations were done, in connection with a dam project at Dharoi. The result of the survey indicates roughly that the project would ensure irrigation for 1,00,000 acres and put the water supply position of Ahmedabad town on a surer footing. We recommend that, in the first instance, activities might be restricted to this one project only in this basin. At our request the estimate has been recast to provide for the necessary investigations of this project. It amounts to Rs. 7,87,000 and expenditure will be spread over two years, in the first year being Rs. 4,34,000 and in the second year Rs. 3,53,000. The provisions are reasonable and the staff provided is adequate.

In this, as in the case of Narbada and Tapti, discharge and silt observations, meteorological observations etc., will be taken up on basin-wide scale and provision has been made in the recast estimate.

## 5. C. P. & 6. BASTAR PROJECTS.

### (APPENDIX VII)

#### *Items II to V of the Terms of Reference.*

*II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order*

*III. Is the cost of investigations, provided in the above proposals justified?*

*IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate?*

*V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects?*

#### 5. (C.P.)

Besides Narbada and Tapti basins, it is also proposed to undertake investigations for development in the mid-Godavari and upper Mahanadi basins. The projects in the mid-Godavari basin were principally on the Wainganga and Wardha tributaries of the Godavari. In view of the fact that a very big project is being undertaken by the C. P. engineers on the lower Wainganga we consider it desirable for the present for the CWINC to concentrate on the upper Mahanadi basin only. There are four projects, three on the tributaries and one on the main river which appear to be very promising and will result in assuring irrigation for 6,50,000 acres of land and enable 23,000 k.w.s. of continuous power being generated. The regulated supplies from these projects will also increase the power potential of the Hirakud and other lower projects on lower Mahanadi. The work of investigations could be taken up by one Division.

At our request the estimate for investigations has been recast and now amounts to Rs. 27,04,500 for the Mahanadi basin in place of Rs. 47,44,000 for the Mahanadi and Godavari basins. In the recast estimate costs of surveys by Survey of India have been reduced as in other cases. Other provisions are reasonable and the staff provided adequate.



As in the case of other valley investigations, the silt mineral, meteorological and other general investigations will be carried out over the whole basin.

## 6. (BASTAR).

The area of what until recently was known as Bastar State is very sparsely populated. Cultivation is done on a very restricted scale and mineral resources, which are very great have not at all been explored or exploited. A good part of the state is on a plateau at an elevation of over 2,000 ft. above mean sea level. The rainfall is good and the climate exhilarating.

On these accounts it is not unlikely that the territory might be utilized for resettling and rehabilitating refugees from Western Pakistan. This, we find, can be achieved without disturbing or encroaching upon the areas occupied by the tribal population.

The principal river of the state, Indravati, has great potential for Power development which is absolutely necessary for the rich iron ores aggregating to over 1,000 million tons, containing 68 per cent to 70 per cent pure iron to be utilised for manufacture of steel etc. Some good sites have been located where development will be very attractive. The power potential of these projects will be in the neighbourhood of 3,00,000 k.ws. continuous.

On the Sabri river one project has been located which would enable bringing under irrigation 6,90,000 acres of land, and produce 14,000 k. ws. of continuous power.

We agree that all these projects should be investigated on a priority basis and the proposal to set up one Division for the purpose has our approval. The estimate amounts to Rs. 27,04,000 and the expenditure would be spread over 3 years. The provisions made in the estimate are reasonable and the staff proposed adequate.

One Superintending Engineer would be necessary to control the two Divisions in this region, i.e., one in the Upper Mahanadi and the other in Bastar State. The estimates provide for the entertainment of a Superintending Engineer and his office staff.

Total expenditure on investigations in C. P. and Bastar rivers will thus be Rs. 54,09,000 spread over three years. The yearly expenditure will be Rs. 18,00,000 in the first year, Rs. 20,00,000 in the second year and Rs. 16,09,000 in the third year. They are in order and compare favourably with the estimates for the years 1947-48 and 1948-49 amounting to Rs. 16.52 lacs (Provision was for 13 months only).

## 7. ASSAM PROJECTS.

### (APPENDIX VIII)

#### *Items II to V of the Terms of Reference*

*II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order?*

*III. Is the cost of investigations provided in the above proposals justified?*

*IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate?*

*V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects?*

The territory, with its magnificent rivers and the narrow gorges in the Himalayan ranges through which they flow, offers an almost unlimited scope for power development. CWINC, in consultation with the Government of

Assam, have selected for the present four projects for preliminary investigations. An estimate amounting to Rs. 50,00,000 to cover the cost and programmes of expenditure for the years 1947-48 and 1948-49 amounting respectively to Rs. 2,67,000 and Rs. 20,41,000 have been examined by us and are, in our opinion, reasonable. But, for considerations similar to those which have led us to recommend curtailment of activities in other basins, we suggest that only two out of the four projects should be taken up for investigation at present. These, in our opinion, should be Manas and Dihang. The priorities allotted to the projects should be changed to give Manas the higher, as it is close to the rest of India and not too far from the industrial area of Assam. This project has a bigger irrigation potential as well. Besides, the channel below is likely to provide a link for the navigation canal which is being thought of from the Teesta barrage to the Brahmaputra. The Dihang will be No. 2 priority, but taken up simultaneously for investigation.

In addition to discharge and silt observations, meteorological, mineral and economic surveys, and surveys for navigation should be planned for the entire area. A recast estimate to cover our recommendation has been prepared and now amounts to Rs. 30,73,700 spread over two years. Expenditure will be Rs. 14,00,000 in the first and Rs. 16,73,700 in the second year. The provisions are reasonable and staff provided adequate, one of the three divisions previously provided having been curtailed.

## 8. COORG PROJECTS.

### (APPENDIX IX)

#### *Items II to V of the Terms of Reference.*

*II. Are the proposals in respect of each one of the above projects, as put forward by CWINC, in order?*

*III. Is the cost of investigations provided in the above proposals justified?*

*IV. Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff, provided in the estimates for the purpose, adequate?*

*V. Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects?*

The estimate to investigate the projects in Coorg viz. Herangi Irrigation and Power Project, the Baropole Hydel Project, the Lakshmantirtha Irrigation Project and the projects for renovation of irrigation tanks, amounting to Rs. 6,64,740 and one for the year 1948-49 amounting to Rs. 2,24,000 have been examined. We suggest that work of investigations on renovation of tanks be omitted and the proposals should be amended to provide for only two S. D. Os. and the adequate number of subordinates and clerical staff instead of one Executive Engineer and three S. D. Os. The work of investigations could be completed in about two years. The estimate has accordingly been amended and now amounts to Rs. 4,52,000 and the expenditure for the year 1948-49 and 1949-50 will be respectively Rs. 2,20,000 and Rs. 2,32,000. The provisions are reasonable and the expenditure will be justified. The staff provided is adequate.

### GENERAL.

Before concluding we would like to bring to the notice of the Government that some special allowance should be given to officers and men on field duties in connection with investigation and construction of such projects as the localities where they have to work are generally unhealthy, communications are difficult and the work arduous. Unless an incentive in the shape of such allowance is given people would generally prefer to be on less arduous jobs elsewhere. This particular point was not amongst our terms of reference.

but we feel it would not be fair not to bring this aspect to the notice of Government, as it is only contented staff that could be relied upon to do the work efficiently and economically specially in these days of shortages.

The original estimates placed before us are appended, as also the estimates now prepared which are approved by us."

(Sd.) A. N. KHOSLA.

(Sd.) J. L. SAVAGE.

(Sd.) M. NARASIMHAIYA.

DATED NEW DELHI ;     }  
*the 18th May 1948.*     }

## APPENDIX I

Terms of Reference of the *Ad-hoc* Committee, appointed by the Government of India in the Ministry of Works, Mines and Power in connection with the investigations of the River-valley projects, sponsored by the C.W.I.N.C.

“ The projects concerned are :—

1. Kosi,
2. Narbada,
3. Tapti,
4. Sabarmati,
5. Central Provinces }  
& 6. Bastar rivers, }
7. Asasm Valley, and
8. Coorg.

*Item I*—What would you consider to be a reasonable cost of investigations of a project in relation to the overall capital cost of that project ?

*Item II*—Are the proposals in respect of each one of the above projects, as put forward by C.W.I.N.C., in order ?

*Item III*—Is the cost of investigations provided in the above proposals justified?

*Item IV*—Keeping in mind the proposed programme and priorities of investigations, is the proposed strength of engineering staff provided in the estimates for the purpose adequate ?

*Item V*—Is it possible, by a re-arrangement of programme or priorities, to reduce expenditure, or at least spread it over a longer period, in respect of one or more of these projects ?

*Item VI*—In respect of the Kosi Project, in particular, what are your views ? as to

- (a) the desirability of obtaining from Disposals construction machinery to the extent of nearly Rs. 40 lacs in anticipation of the construction of barrage, canals and dams ; the expenditure to be treated as suspense in the first instance and charged to the project when the latter receives sanction : this course was followed in connection with the Hirakud Dam Project ; and
- (b) the desirability of
  - (i) undertaking the construction of a meter gauge railway line to the barrage and dam sites (length nearly 40 miles), and
  - (ii) undertaking the construction of the barrage and canal systems in advance of the construction of the dam.”

# IMPORTANT DATA IN RESPECT OF VARIOUS PROJECTS

No.	Name of Project	Amount of original estimate by years in lac of rupees					Total Allocation required from year to year					POTENTIAL DEVELOPMENT					Priority Projects					REMARKS	
		1st	2nd	3rd	...	...	Overall cost of investigations for the approved Whole Basin in lac of Rupees	1	2	3	4	5	Flood control	Irrigation in million acres		Continuous Power in K. W.	Navigation	Flood control	Irrigation in million acres		Continuous Power in K. W.		Navigation
														Gross comm- auded area	Irrig- able area				Gross comm- auded area	Irrig- able area			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
1	Kosi	16.44	15.00	...	One crore (approx.)	One crore	18.32	14.00	14.00*	Would reduce 7 lakhs flood to 2 1/2 lakh flood.	7.0	4.20	1.3 Million	Ganges junction to 50 miles above Barahatshetra in Nepal.		Same as whole Basin				Barrage and canals may be constructed in advance of the dam.			
2	Narbada Valley	1.71	25.91	...	95.91	64.97	26.97	19.00	19.00	Complete	3.7	2.22	Over one million kws.	Sea to Hoshangabad Complete		3.7	2.22	3,16,000	Sea to Hoshangabad 400 miles				
3	Tapti Valley	2.605	20.56	..	42.25	19.955	12.0	7.955	...	Complete	1.29	0.774	63,000	Kakrapara to Surat Complete		0.7	0.42	48,000	Kakrapara to Surat 40 miles				
4	Sabarmati	0.28	5.20	...	15.10	7.87	4.34	3.53	...	Complete	0.2	0.12	Not calculated	Gulf of Cambay to Partial Junction of Hathmati		0.1	0.06	..	Gulf of Cambay to junction of Hathmati	Reserving 100 cusecs for Ahmedabad water supply.			
5	G. P. & Berar	2.23	14.29	...	71.17	54.09	16.00	20.90	18.00	No problem	2.1	1.26	310,000	Baster will open up to navigation through Godavari	Complete	1.35	0.81	184,000	with possibility of raising 3 lacs by Bhopal Patnam Dam.	Investigations on Mid Godavari basin have been omitted			
6	Bastar																						
7	Assam Valley	2.67	20.41	...	50.00	30.737	14.00	16.737	..	Partial exact extent can not be worked out	2.6	1.56	16,00,000	Barak & Dihang Manes will be navigable for considerable distances in land		Not calculated	Not calculated	12.4 lacs.	Manes and Dihang will be navigable for considerable distance up to be omitted for the present stream of the dam sites on them				
8	Coorg	2.24	...	...	6.6474	4.52	2.20	2.32	...	No problem	0.12	0.72	49,500	Nil	No problem	0.01	0.006	49,500	Nil	Renovation of Irrigation and pisciculture tanks fitted.			

\* While other investigations are expected to finish by 1950 the enabling construction to be taken in hand before that year, survey work in the Kosi flood plain for irrigation and drainage work will continue for a number of years and the construction of canals and distributaries will progress as survey proceeds.

APPENDIX II  
KOSI PROJECT  
REPORT

At their meeting held on the 29th July, 1946, the Standing Finance Committee agreed to an expenditure of Rs. 31.44 lakhs on the preliminary surveys and investigations for the Kosi Project during the year 1946-47 and 1947-48. This sanction was communicated in W. M. P. letter No. D.W. 1201 (1), dated, the 27th May, 1946.

2. The previous estimate had been framed with a view to ascertain the feasibility of the scheme. Investigations so far carried out have now shown that the scheme is definitely feasible and therefore investigations have now to be carried out in greater detail. Owing to difficult situation of the site and the enormity of the magnitude of the work, the detailed investigations will have to extend beyond 1950 but they shall have progressed sufficiently by March 1950 to enable construction to be taken in hand. This estimate amounting to Rs. 65,26,000 has therefore been prepared to cover the period ending March 1950 and includes the amount of Rs. 31,44,000 already sanctioned. For completing the investigations the cost will be of the order of rupees one crore.

3. The present estimate covers the cost of investigations for the dam (excluding the cost of trial load analysis to be carried out in America, the cost for which will be included in the supplementary estimate for overall investigations) and the investigations for the barrage site and surveys for a portion of the area to be irrigated to the east of the Kosi. The survey work, owing to its magnitude, will take a number of years to complete. The construction of the barrage can however be taken in hand without waiting for the completion of surveys for the irrigation area and the construction of irrigation system can proceed as surveys progress. For the present, it is proposed to concentrate on the surveys and investigations of the canal system to the east of the Kosi. The cost of the remaining surveys will be included in the supplementary estimate for the overall investigations.

4. Credit has been allowed in the estimate for the recovery value of T. & P. as also of buildings most of which have been provided in pre-fabricated structures.

(Index map showing dam site, etc. is enclosed)

BALWANT SINGH NAG,  
*Project Officer (Kosi).*

## KOSI PROJECT

Estimate for preliminary surveys and investigations for the Kosi Project for the period, ending March 1950.

<i>Abstract</i>	<i>Ra.</i>
1. Surveys by Survey of India . . . . .	22,70,000
2. Surveys under C. W. I. N. C. . . . .	37,500
3. Discharge Observations . . . . .	80,500
4. Silt Observations . . . . .	18,000
5. Property Surveys . . . . .	21,400
6. Ground Water Surveys . . . . .	Nil
7. Meteorological Surveys . . . . .	2,93,900
8. Seismological Surveys . . . . .	1,14,000
9. Geological Investigations . . . . .	12,03,750
10. Roads and Paths . . . . .	1,67,000
11. Aerial Ropeways . . . . .	48,000
12. Soil conservation survey for controlling silting of Dam . . . . .	80,000
13. Agricultural and Soil surveys for Irrigation . . . . .	60,000
14. Survey of Fish Fauna . . . . .	5,000
15. Industrial and Load Surveys . . . . .	5,000
16. Wooden Models . . . . .	10,000
17. Temporary accommodation . . . . .	2,70,000
18. Camp equipage . . . . .	96,000
19. Tools and Plants new supply . . . . .	2,33,900
20. Repairs and carriage to T. & P. . . . .	60,000
21. Laboratory at Barakeshtra . . . . .	15,000
Total . . . . .	50,88,350
Say . . . . .	50,88,400
22. Contingencies on Rs. 50,88,400 at 5% . . . . .	2,54,400
23. Establishment (Salary T. A. and contingencies) . . . . .	11,83,000
Grand Total . . . . .	65,25,800
Say . . . . .	65,26,000

{ BALWANT SINGH NAG  
Project Officer (Kosi).

## Estimate of preliminary surveys and investigations for the period, ending March 1950

S. No.	Item	Estimated cost	Total
1	2	3	4
		Rs.	Rs.
1.	<i>Surveys to be carried out by survey of India under guidance of the C. W. I. N. C.—</i>		
	(a) For <del>F</del> dam Site—		
	Comprising aerial-photography of the gorge and the reservoir area, survey and map publication of the dam site to scales add of		
	i. 1=1000		
	ii 32"=1 mile		
	Survey and map publication of the reservoir area and the Chatra gorge to a scale of 4"=1 mile with 20' contour interval and 1" or near scale survey of Dudh Kosi reservoir site (in Nepal)	2,50,000	
	(b) For irrigation and drainage area to a scale of 4"=1 mile East of Kosi including the river (part area only) 20,00,000 acres, at Re. 1 per acre.	20,00,000	
	(c) Cost of various photomosaics, and project maps for detailed study and publication of map-plates and appendices for the "Project Report"	20,000	22,70,000
2.	<i>Surveys to be carried out by or under the direction of the C. W. I. N. Commission.—</i>		
	(a) Longitudinal section of the river and x-sections (1000' apart) 50 miles at Rs. 100 per mile	5,000	
	(b) Surveys for railway and road alignments for the dam and the barrage	20,000	
	(c) Alignment of Eastern Kosi Canal and branches : 500 miles at Rs. 25 per mile	12,500	37,500
3.	<i>Discharge Observations.—</i>		
	Number of sites . . . . . (6)		
	Expenditure per site (non-recurring) Rs.		
	Current Meters 1½ . . . . . 1,250		
	Boat large 1 . . . . . 1,000		
	Boat small 1 . . . . . 600		
	Sounding rods etc. . . . . 150		
	Ropes . . . . . 500		
	3,500	21,000	
	Recurring Expenditure for 2 years per site.		
	Head boatman at Rs. 75 p. m. . . . . 1,800		
	4 khalasis cum-boatmen at Rs. 60 p.m. . . . . 5,760		
	Ropes at Rs. 200 per annum . . . . . 400		
	7,960		
	(Say Rs. 8,000)	48,000	
	Temporary gauge readers for flood season 24 Nos. for 4 months per year for two years at Rs. 60 p.m. . . . . 11,520 Say	11,500	80,500
4.	<i>Silt Observations.—</i>		
	Number of sites . . . . . (5)		
	Equipment (non-recurring) per site Rs. 1,000 . . . . . 5,000		
	Recurring expenditure for 2 years : 2 khalasis per site at Rs. 55 p.m. . . . . 13,200		
	Say 13,000	18,000	18,000
5.	<i>Property Survey.—</i>		
	For 9 months—		
	4 Surveyors at Rs. 180 p.m. . . . . 6,480		
	10 Khalasis at Rs. 55 p.m. . . . . 4,950		
	Camp charges . . . . . 5,000		
	Staff on deputation from Nepal . . . . . 5,000		
	21,430	Say 21,400	21,400



6. *Ground Water Surveys.*—

These will be done by staff.

Nil

7. *Meteorological Surveys.*—

(Figures given by Meteorological Department)

Class I	Observatories ,	2 Nos.			
Class II	Observatories ,	2 Nos.			
Class III	Observatories ,	6 Nos.			
Class IV	Observatories ,	20 Nos.			
(a)	Non-recurring expenditure.		Rs.	Rs.	
(i)	Equipment . . . . .		79,700		
(ii)	Installation charges including buildings . . . . .		48,800	1,28,500	
(b)	Recurring charges for two years.				
	Pay of Officers . . . . .		4,800		
	Pay of staff . . . . .		1,00,000		
	Dearness allowance . . . . .		50,000		
	T. A. & contingencies . . . . .		10,000	1,64,800	2,93,300
					2,93,300

8. *Seismological Surveys.*—

(Based on figures given by Meteorological Department)

(a)	Equipment (non-recurring)				
	One Cambridge Universal Vibrograph			45,000	
	One Venner's 12" Accelerograph				
	Two units Milneshaw horizontal component Seismograph				
	One Benioff vertical seismograph			24,000	
	Six wood-Anderson seismographs . . . . .				
				69,000	
(b)	Buildings for observatories . . . . .			20,000	
(c)	Recurring expenditure for two years—				
	Pay of staff . . . . .	13,000	..		
	Allowances & Honoraria . . . . .	6,000	..		
	Contingencies . . . . .	6,000	25,000	1,14,000	1,14,000

9. *Geological Investigations.*—

(a)	Equipment (non-recurring)			
	Diamond drills 6 Nos. . . . .	1,80,000		
	Diamonds & spares for above . . . . .	2,40,000		
	Calyx drill complete . . . . .	20,000		
	Spares for above . . . . .	5,000		
	Special boats for drills 4 sets . . . . .	10,000		
	Derrick, steel cables etc. . . . .	5,000		
	Compressors 4 Nos. at 5000 . . . . .	20,000		
	Pumps 2 Nos. . . . .	6,000		
	Hoists for vertical shafts : 2 Nos. . . . .	10,000		
		4,96,000		
(b)	Labour and consumable stores for			
(i)	30,000' of diamond drilling at 12 per foot . . . . .	3,60,000		
(ii)	2 Vertical shafts for under river tunnel 200' deep each 48" diameter at Rs. 100 a foot . . . . .	40,000		
(iii)	Cross tunnel under the river 500' at Rs. 100 per foot . . . . .	50,000		
(iv)	Drifts 7' x 5' length 8000' at Rs. 50 per foot . . . . .	4,00,000		
		8,50,000		
(c)	Specialists.—			
	One drill foreman at Rs. 2000 p.m. for 2 years . . . . .	48,000		
	Subsistence allowance for above at Rs. 584 p.m. = 14,016 say . . . . .	14,000		
	Passage both-ways . . . . .	7,500		
	Consulting Geologist's fees . . . . .	15,000		
	Resident Geologists 2 Nos. for one year at Rs. 350 p.m. . . . .	8,400		
	Dearness Allowance, T. A. etc. . . . .	3,600		
		96,500		

14,42,500

Deduct cost of tools and plants detailed below which will be available for use on other works to be taken on stock suspense for further use on other works.		Rs.	Rs.	Rs.
75% of Rs. 1,80,000, the cost of drills . . . . .	Rs. 1,35,000			
75% of Rs. 20,000, the cost of calyx drill . . . . .	15,000			
Spares . . . . .	50,000			
75% of Rs. 10,000 the cost of special boats . . . . .	7,500			
75% of Rs. 5,000, the cost of Derrick steel cables . . . . .	3,750			
75% of Rs. 20,000, the cost of compressors . . . . .	15,000			
75% of Rs. 6,000, the cost of pump . . . . .	4,500			
80% of Rs. 10,000 the cost of hoists . . . . .	8,000		2,38,750	12,03,750
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10 Roads and Paths.—				
(a) Construction—				
(i) Widening and improving existing path between Barakeshtra and Chatra . . . . .	20,000			
(ii) Tow Path from Chatra to Dam site right bank 6 miles . . . . .	10,000			
(iii) Foot path from Barakeshtra to Tribeni, left bank . . . . .	25,000			
(iv) Foot path from Barakeshtra to Tribeni right bank . . . . .	17,000			
(v) Foot paths along both banks of the Tamur from Tribeni to gauge site . . . . .	4,000			
(vi) Foot path along the Sun Kosi from Tribeni to gauge site. . . . .	2,000			
(vii) Foot path along the Arun from Tribeni to Machwaghat 3 miles . . . . .	4,000			
(viii) Improvement of cart track and constructing kutcha road from Chatra to barrage site . . . . .	20,000			
			1,02,000	
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(b) Maintenance of Roads & Paths—				
(i) Kutcha road from Jogbani to Chatra 40 miles and Chatra to barrage site 16 miles . . . . .	40,000			
(ii) All other foot paths . . . . .	25,000	65,000		1,67,000
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11 Aerial ropeway across the Sapt Kosi, the Tamur, the Arun and the Sun Kosi, 4 Nos. at Rs. 12,000 each . . . . .		48,000		48,000
12 Soil Conservation Surveys . . . . .		80,000		80,000
13 Agricultural and soil survey for irrigation 4 million acres at 15,000 per million acres . . . . .		60,000		60,000
14 Survey of Fish Fauna . . . . .		5,000		5,000
15 Industrial and Load Survey . . . . .		5,000		5,000
16 Wooden models . . . . .		10,000		10,000
17 Temporary Accommodation.—				
(a) Dam Investigation.—				
Non-Residential.—				
Administrative Quarters at Barakeshtra . . . . .	8,500			
(i) Inspection Houses at Barakeshtra and Jogbani at 7,000 each . . . . .	14,000			
(ii) M. B. Sheds for stores and workshops at Barakeshtra . . . . .	11,000			
(iii) Store Shed at Chatra . . . . .	8,000			
(iv) Laboratory and Store shed at Barakeshtra and Tribeni 2 Nos. . . . .	16,000			
(v) M. B. Shed Class IV . . . . .	10,000			
(vi) Petrol godown . . . . .	1,000			
(vii) Magazine for explosives . . . . .	4,000			
(viii) Dispensary building . . . . .	3,000			
(ix) Office building for Divisional and Sub-Divisional offices . . . . .	18,000			
(x) Sheds for skilled and unskilled labour 200 No. . . . .	10,800			
(xi) Sheds for cooking meals for the above labour . . . . .	4,200			
(xii) Miscellaneous buildings . . . . .	14,000	1,22,500		

		Rs.	Rs.	Rs.
<i>Residential—</i>				
(i)	Executive Engineer's Bungalow . . . . .	6,000		
(ii)	Residences for six gazetted officers (3 S. D. Os., 2 Geologists and 1 Meteorologist) . . . . .	18,000		
(iii)	Accommodation for clerks, drawing staff storekeepers, compounders and laboratory assistants 25 Nos. . . . .	25,000		
(iv)	Accommodation for supervisors, Silt Analyst, Research Assistant: 25 Nos. . . . .	40,000		
(v)	Drill Foreman's quarter: 1 No. . . . .	5,000		
(vi)	S. D. Os. visiting quarter at Tribeni . . . . .	1,500		
(vii)	Time Keepers, gauge readers, Daffadars, Barkandazes, Peons, Chowkidars, Dak runners, Boatmen, Nepalese guards, Sweepers' quarters at Rs. 350 each 80 Nos. . . . .	28,000		
(viii)	Servants quarters at camp sites : 3 Nos. . . . .	1,500		
		1,25,000	1,25,000	
(b)	Irrigation and Drainage investigations.— Accommodation for officers and stores sheds etc. L. S. 50,000 for each division 2 Nos. . . . .		1,00,000	
			3,47,500	
	Deduct the cost of materials from prefabricated structure like M. B. Sheds, Lahore Sheds Nissen Sheds which will be available for use on other Projects to be taken on stock suspense and credited to this work . . . . .		77,000	
			2,70,000	2,70,000
18	<i>Camp Equipage.—</i>			
(i)	<i>For Dam Division.—</i>			
	4 Tents 14'×14' @ 1,400 . . . . .	5,600		
	12 Tents 10'×10' @ 800 . . . . .	9,600		
	6 necessary tents @ 150 . . . . .	900		
	30 shouldaries @ 350 . . . . .	10,500		
	Camp furniture . . . . .	7,500		
	Repairs and carriage of furniture . . . . .	5,000	39,100	
(ii)	<i>For Irrigation Divisions.—</i>			
	4 Tents 14'×14' @ 1,400 . . . . .	5,600		
	8 tents 12'×12' @ 1,100 . . . . .	8,800		
	15 tents 10'×10' @ 800 . . . . .	12,000		
	30 shouldaries @ 350 . . . . .	10,500		
	Camp furniture . . . . .	10,000		
	Repairs and carriage of Camp equipage . . . . .	10,000	56,900	96,000
19	<i>Tools and Plant.—</i>			
(i)	<i>Special Tools.—</i>			
	<i>For Kosi Dam Division.—</i>			
	Jeeps with Trailers 2 Nos. @ 6,000 . . . . .	12,000*		
	Weapon carrier trucks 6 Nos. @ 6,000 . . . . .	36,000*		
	G. M. C. Trucks 4 Nos. @ 10,000 . . . . .	40,000*		
	Country boats 18 Nos. @ 1,000 . . . . .	18,000		
	Inspection boats 4 Nos. @ 1,200 . . . . .	4,800*		
	Motor boats 2 Nos. @ 8,000 . . . . .	16,000*		
	<i>For Irrigation Division.—</i>			
	Jeeps and trucks 2 Nos. @ 6,000 . . . . .	12,000*		
	Weapon carriers 8 Nos. @ 6,000 . . . . .	48,000*		
	Boats 8 Nos. @ 1,000 . . . . .	8,000		
(ii)	<i>Instruments.—</i>			
	<i>For Kosi Dam Division.—</i>			
	Levels 12 Nos. @ 1,000 . . . . .	12,000**		
	Theodolites 3 Nos. @ 3,500 . . . . .	10,500**		
	Binoculars 4 Nos. @ 200 . . . . .	800**		
	Cameras 2 Nos. at 400 . . . . .	800**		
	Miscellaneous Surveying and Drawing Instruments . . . . .	5,000		

	Rs.	Rs.	Rs.
<i>For Kosi Irrigation Divisions.—</i>			
Levels 24 Nos. at 1,000 . . . . .	24,000**		
Theodolites 6 Nos. at 3,500 . . . . .	21,000**		
Other surveying and drawing instruments	10,000		
Soil testing and Laboratory equipment . . . . .	10,000		
<i>(iii) Office Furniture and other T. &amp; P.—</i>			
<i>For Kosi Dam Division.—</i>			
Office furniture for Executive Engineer and S. D. O's. . . . .	6,000		
<i>For Kosi Irrigation Divisions.—</i>			
Miscellaneous T. P. at 10,000 per Division . . . . .	20,000		
Office furniture for Executive Engineer and Sub. Division Officers . . . . .	12,000	3,26,900	
Deduct cost of stores likely to be available for use on other works and projects after completion of the investigation to be taken on stock suspense and cost to be credited to this work as under :—			
25% of the cost of items marked * pre-page	42,000		
75% of the cost of items marked ** above	51,000		
		93,000	2,33,900
20 Repairs and Carriage of vehicles . . . . .	60,000	60,000	
21 Silt and chemical laboratory at Barakeshtra . . . . .	15,000	15,000	
22 Contingencies at 5% on the amount of Rs. 50,88,400	2,54,400	2,54,400	
23 <i>Establishment.—</i>			
<i>(i) Kosi Dam Investigation Division.—</i>			
1 Executive Engineer for 3 years @ 1,150 p.m.	41,400		
3 Asstt. Engineers for 3 years @ 350 p.m. . . . .	37,800		
15 Supervisors for 3 years @ 150/-p.m. . . . .	81,000		
1 Accountant for 3 years @ 235/-p.m. . . . .	8,460		
1 Head Clerk for 3 years @ 170/-p.m. . . . .	6,120		
3 Sub Divisional Clerks for 3 years @ 80/-p.m. . . . .	8,640		
1 Accounts Clerk for 3 years @ 100/-p.m. . . . .	3,600		
4 Clerks for 3 years @ 55/-p.m. . . . .	7,920		
6 Clerks for 2 years @ 55/-p.m. . . . .	7,920		
1 Sr. Draftsman for 3 years @ 150/-p.m. . . . .	5,400		
1 Jr. Draftsman for 3 years @ 140/-p.m. . . . .	5,040		
1 Tracer for 2 years @ 60/-p.m. . . . .	1,440		
1 Ferro Printer for 2 years @ 60/-p.m. . . . .	1,440		
1 Civil Asstt. Surgeon for 3 years @ 370/-p.m. . . . .	13,320		
1 Compounder for 3 years @ 60/-p.m. . . . .	2,160		
1 Research Asstt. for 3 years @ 160/-p.m. . . . .	5,760		
3 Silt Analysts for 3 years @ 100/-p.m. . . . .	10,800		
1 Silt Analyst for 2 years @ 100/-p.m. . . . .	2,400		
1 Laboratory Asstt. for 2 years @ 60/-p.m. . . . .	1,440		
1 Laboratory Attendant for 2 years @ 40/-p.m. . . . .	960		
1 Seismological Asstt. for 1 year @ 160/-p.m. . . . .	1,920		
1 Senior observer for 1 year @ 100/-p.m. . . . .	1,200		
1 Junior observer for 1 year @ 60/-p.m. . . . .	720		
6 Gauge Readers for 3 years @ 35/-p.m. . . . .	7,560		
4 Deffadars for 3 years @ 30/-p.m. . . . .	4,320		
6 Barkandazes for 3 years @ 30/-p.m. . . . .	6,480		
8 Peons for 3 years @ 30/-p.m. . . . .	8,640		
7 Nepalese Police Guards for 3 years @ 35/-p.m. . . . .	8,820		
1 Dispensary servant for 3 years @ 30/-p.m. . . . .	1,080		
2 Storekeepers for 2 years @ 80/-p.m. . . . .	3,840		
4 Special pay for handling cash for 3 years at 20/-p.m. . . . .	2,880		
Add provision for increments . . . . .	10,000		
		3,10,480	
<i>(ii) Irrigation and Drainage Investigation Divisions.</i>			
2 Exec. Engineers for 2 years @ 1,000/-p.m.	48,000		
6 Asstt. Engineers for 2 years @ 350/-p.m. . . . .	50,400		
20 Supervisors for 2 years @ 150/-p.m. . . . .	72,000		
2 Accountants for 2 years @ 200/-p.m. . . . .	9,600		
2 Head Clerks for 2 years @ 160/-p.m. . . . .	7,680		

2 Accounts Clerks for 2 years	@ 100/-	p.m.	4,800
6 Sub-Divisional for 2 years	@ 80/-	p.m.	11,520
16 Asstt. Clerks for 2 years	@ 55/-	p.m.	21,120
2 Storekeepers for 2 years	@ 80/-	p.m.	3,840
1 Sr. Draftsman for 2 years	@ 150/-	p.m.	3,600
2 Jr. Draftsman for 2 years	@ 100/-	p.m.	4,800
2 Tracers for 2 years	@ 60/-	p.m.	2,880
2 Ferroprinters for 2 years	@ 60/-	p.m.	2,880
6 Gauge Readers for 2 years	@ 35/-	p.m.	5,040
8 Daffadars for 2 years	@ 30/-	p.m.	5,760
24 Barkandazes for 2 years	@ 30/-	p.m.	17,280
16 Peons for 2 years	@ 30/-	p.m.	11,520
1 Asstt. Soil Specilist for 1 year	@ 350/-	p.m.	4,200
6 Soil Analysts for 2 years	@ 100/-	p.m.	14,400
1 Peon for 1 year	@ 30/-	p.m.	360
8 Special pay for handling cash for 2 years at 20/-p.m.			3,840
Add provision for increments for 1 year			20,000

3,29,120

## (iii) Direction Office.—

1 Stenographer for 2 years	@ 170/-	p.m.	4,080
1 Superintendent for 2 years	@ 250/-	p.m.	6,000
1 Circle Clerk 2nd for 2 years	@ 160/-	p.m.	3,840
3 Upper Division Clerks for 2 years	@ 90/-	p.m.	5,760
4 Lower „ „ „ years	@ 55/-	p.m.	5,280
1 Sr. Draftsman for 2 years	@ 150/-	p.m.	3,600
1 Jr. Draftsman for 2 years	@ 100/-	p.m.	2,400
1 Tracer for 2 years	@ 60/-	p.m.	1,440
1 Ferroprinter for 2 years	@ 60/-	p.m.	1,440
1 Daftri for 2 years	@ 35/-	p.m.	840
6 Peons for 2 years	@ 30/-	p.m.	4,320
1 Barkandaz for 2 years	@ 30/-	p.m.	720
1 Special Pay for handling cash for 2 years at 20/- p.m.			480
Add provision for increaments			2,200

## (b) Dearness and Nepal Compensatory allowances.]

42,400

S. No.	Class of Estt.	No.	Period in Yrs.	D. A. Rs.	Nepal Allee. Rs.
1	Executive Engineer	1	3	4,140	5,400
	Executive Engineers	2	2	4,800	..
2	Asstt. Engineers	3	3	7,560	8,100
		6	2	10,800	1,800
3	Supervisors	15	3	24,300	21,600
		20	2	19,200	3,000
4	Accountants	1	3	1,800	1,080
		2	2	2,160	..
5	Circle Supdt.	1	2	1,200	..
6	Circle 2nd Clerk	1	2	1,080	..
7	Head Clerk	1	3	1,620	1,080
8	Accounts clerk	1	3	1,260	960
9	Head Clerks	2	2	2,160	..
10	Accounts clerks	2	2	1,680	..
11	Upper Div. Clerks	3	2	2,520	..
12	Sub- Div. Clerks	3	3	3,780	2,160
		6	2	5,040	480
13	Steno for Project officer	1	3	1,620	..
14	Clerks	4	3	5,040	2,880
		26	2	21,840	3,360
15	Storekeepers	4	2	3,360	1,440
16	Sr. Draftsman	1	3	1,440	1,080
		2	2	960	..
17	Draftsman	1	3	1,440	1,080
18	Tracers	4	2	3,360	480
19	Ferroprinters	4	2	3,360	480

20	Civil Asstt. Surgeon	.	.	1	3	2,520	2,700		
21	Compounder	.	.	1	3	1,260	720		
22	Dispensary Servant	.	.	1	3	900	360		
23	Research Asstt.	.	.	1	3	1,620	1,440		
24	Silt Analysts	.	.	3	3	3,780	2,700		
				1	2	840	600		
25	Asstt. Soil Specialist	.	.	1	2	1,680	..		
26	Soil Analysts	.	.	6	2	5,040	600		
27	Laboratory Asstt.	.	.	1	2	840	480		
28	Laboratory Attendant.	.	.	1	2	600	240		
29	Seismological Asstt.	.	.	1	1	540	480		
30	Sr. Observer	.	.	1	1	420	300		
31	Jr. Observer	.	.	1	1	420	240		
32	Gauge Readers	.	.	6	3	5,400	2,160		
33	Daffadars	.	.	6	2	3,600	480		
				4	3	3,600	1,440		
				8	2	4,800	240		
34	Barkandazes	.	.	6	3	5,400	2,160		
				25	2	15,000	720		
35	Peons	.	.	8	3	7,200	2,880		
				22	2	13,200	240		
36	Daftri	.	.	1	2	600	..		
37	Peon	.	.	1	1	300	..		
						2,17,080	77,580	2,94,660	9,78,660
									Say 9,77,000

(c) *Travelling Allowances.*—

(i)	For Kosi Dam Division ; @11,000 per year for 3 years	33,000		
(ii)	For 2 Irrigation and Drainage Investigation Divisions @ 11,000 each per year for 2 years	44,000		
(iii)	For supdtg. Engineers Camp staff etc. 4,000 per year for 2 years	8,000	85,000	85,000

(d) *Contingencies.*—

(i)	For Dam Investigation at 13,000 per year for 3 years	39,000		
(ii)	For 2 Investigation Divs. 13,000 each per year for 2 years	52,000		
(iii)	For Direction Office 15,000 per year for 2 years	30,000	1,21,000	1,21,000

Total Establishment charges Rs. 11,83,000

BALWANT SINGH NAG  
Project Officer (Kosi).

## APPENDIX III.

## MINISTRY OF WORKS, MINES AND POWER.

One of the factors governing the attitude of the S. F. C. to River Valley Projects is the high cost of preliminary investigations. Considering the difficulties of transport and the availability of steel and cement, I do not think that Government would be able to undertake a large number of river valley projects within a measurable period. Government are already committed to the Damodar Project as a whole, the Hirakud Dam Project, the Bhakra and Nangal Projects, Rihand, Tungabhadra and Ramapadasagara to mention only a few of the prominent projects which must go ahead in any case. The Kosi Project on which we have already spent a large amount on preliminary investigations must also go ahead. Similar considerations would seem to apply to some of the dams on the Chambal, the Narbada and the Tapi. These projects will tax all our resources and the capacity of CWINC to the utmost for the next 5 years, if not for a longer period. In the circumstances, I am of opinion that CWINC should try and reduce the cost of preliminary surveys on all other projects which are now under contemplation, e.g., projects in the Assam Valley, in the C. P., Coorg and so on. It is quite unnecessary at this stage to undertake aerial survey of all these projects, nor does it seem worthwhile taking up a large number of such projects even for preliminary investigations. We should pick and choose and only take up projects which appear most likely to be profitable and concentrate our energies on such projects. For instance, it will not be possible for many years to utilize all the electrical potential in Assam. The utmost we can aim at is to build one large dam at a suitable site in Assam which will provide power and irrigation. A very rough investigation of the various projects in view will suggest which of them should be taken up for preliminary investigations; similarly in the Central Provinces and other areas. Even on the Mahanadi, I am inclined to think that we should not spend any more money on the third site, viz., Naraj. It will be quite enough if Tikkarpara site is explored. The investigations on the third site may well be undertaken 10 years hence, after Hirakud and Tikkarpara are nearing completion.

2. I have put down my tentative views as a basis for discussion with Mr. Khosla. If he agrees with me, will he kindly reduce his estimates for preliminary investigations of the Narbada-Tapti, Assam Valley, and other schemes before the next meeting of the S.F.C. I do not want the investigations on the Kosi to be curtailed nor on any other projects which are likely to be actually constructed during the next 5 years. But there is no point in spending large sums of money on other investigations which are not likely to be fruitful, at least for the next 5 or 7 years.

Sd. B. K. GOKHALE,

4-3-48.

(Secretary)

Mr. Khosla

D. S. P).

I am in complete agreement with Secretary's views. Will Members and Directors note above and take immediate action as to "A" above in consultation with me so that I can discuss this with Secretary on Monday or Tuesday before I go on tour. This note should come back to me for return to Secy.

Sd. A. N. KHOSLA,

4-3-48.

(Chairman, CWINC.)

## APPENDIX IV. NARBADA VALLEY PROJECTS.

### REPORT

The Narbada river has hitherto been considered as useless for being exploited for either irrigation, power, or navigation, the latter beyond a certain small distance above its outfall into the Gulf of Cambay. In its course through the Broach district of the Bombay Presidency it frequently overflows its banks and floods the country-side on both banks. This fact as well as the projected development of other river basins in the country led the Governments of Bombay and C. P. Berar to request the CWINC to take up the investigations for a basin-wide development of the river with flood control, irrigation, power generation and extension of navigation as the chief objectives in view. They offered to depute some of the Engineering staff necessary for the work and also bear the cost of investigations in case no projects matured.

Accordingly the topography and hydrology of the basin were taken up for study in the CWINC at the beginning of the year 1947. The river drains an area of nearly 40,000 sq. miles. The total annual precipitation of rain in the basin is normally over 90 million acre feet of water. At present the entire amount is running to waste into the sea. The river has a deep channel almost throughout its course except in the plains of Broach after it emerges from the last narrow gorge near Rajpipla. The bed slopes vary from a maximum of about 40 feet a mile to about 3.75 ft. a mile through the last gorge. In the Broach plains it flattens out to about  $2\frac{1}{2}$  to 3 inches per mile. Almost throughout its course it flows over basaltic formations.

A study of the topography has revealed that excellent storage sites exist both on the main river and on some of its tributaries where, by constructing dams of medium heights, reservoirs of varying capacities can be formed to hold back the excessive precipitation of rain during monsoon months and utilize the water for purposes of perennial irrigation, power generation, extension of navigation, fish culture and supplies for domestic uses all over the basin. Floods in the Broach area can be completely controlled by reserving the upper portion of their capacities for flood absorption in some of the lower reservoirs.

Most of these sites have been inspected both by Engineers and Geologists and the preliminary ground surveys have revealed that development of projects at the sites is feasible. It has been decided to take up, for the present, investigations of only 7 projects, a list of which is appended. The last two items of the list show the power and irrigation potential of the projects, which will aggregate to nearly one million k.w. of continuous power and a gross command of nearly 4 million acres respectively. The estimate amounting to Rs. 95,91,144 has been prepared to meet the cost of detailed investigations of these projects. Provisions have been made for collection of hydrological data including rainfall, temperature, and humidity and river gauging; surveys of dam sites, the reservoir areas and areas to be commanded for irrigation; soil surveys of the commanded area and geological surveys of the dam sites. Such other surveys as minerals of the entire basin, electrical load surveys, surveys for navigation, soil erosion and also economic surveys by Gokhale Economic Research Institute, Poona, have also been included in the programme of investigations and requisite provisions made in the estimate. Surveys of dam sites reservoir areas and irrigation areas will be done through the agency of the Survey of India Department, while surveys of main canals and other channel alignments for distribution system for irrigation water will be done by CWINC staff. The hydrological surveys will be undertaken in close co-operation with the Indian Meteorological Department. Geological surveys both for minerals and foundation explorations will be done in close co-operation with the Geological Survey of India. Similarly surveys for pisciculture will be undertaken under the direction of the Director, Zoological Survey of India.

Two divisions have been formed to do the work. Each Division will have four subdivisions together with requisite subordinate and ministerial staff. Such other staff as meteorological assistants, Research Assistants for soil survey, Silt Observers, Geologists, Drill foreman etc. has also been provided for, as detailed in the estimate.

The work will take nearly four years to complete. But the investigations will be so phased that construction can be launched upon in case of features which can be taken up independently before the investigations on all projects are completed so as to obtain quick and maximum results. As soon as such stages are reached, estimates for construction will be prepared for sanction.

Adequate provision for acquiring necessary tools and plant and transport vehicles has been made at rates which prevail in the market at present.



A statement showing the rough data for the dam sites and the anticipated benefits from the projects is given below.

*The following map and chart are enclosed :—*

- (1) An index map of the Narbada basin showing the proposed dam sites and projects
- (2) A profile of Narbada river and its main tributaries.

G. N. PANDIT,  
Project Officer (Narbada and Tapti).

## NARBADA BASIN—ROUGH DATA FOR THE DAM SITES

1. Name of the river	Narbada	Burhner	Narbada	Tawa	Narbada	Narbada	Narbada
2. Name of the dam site	Bilghara	Ghugri	Bargi	Rampur	Punasa	Barwani	Weir below gorge
3. Length along river (Miles)	153	85	249	95	513	665	750 (approx.)
4. Latitude and Longitude of dam site	80°29'20"E 22°49'40"N	80°42'0"E 22°44'45"N	79°55'30"E 23°1'0"N	77°59'0"E 22°35'30"N	76°28'0"E 22°17'0"N	74°41'0"E 22°2'0"N	
5. Catchment area above dam site (Sq. miles)	1900	1290	6180	2340	23600	32000	
6. Average rainfall in catchment (Inches)	60	60	55	59	45	42	
7. Probable mean annual runoff (m. a. ft.)	3.06	2.06	4.8	3.12	15.63	22.23	
8 R. L. of river bed	1520	1570	1240	1020	650	350	
9. Proposed F. T. L.	1750	1745	1350	1190	887	590	
10. Maximum height of the dam at F. T. L. (feet)	230	175	110	170	237	240	
11. Length of the dam at F. T. L. (feet)	3960	5300	5120	2700	2400	2000	
12. Gross capacity of reservoir at F. T. L. (m.a.ft.)	1.90	1.57	2.59	5.0	17.14	25.13	
13. Dead storage (m.a.ft.)	0.19	0.13	0.29	1.5	1.52	2.35	
14. Max. area of water spread (acres)	22900	32000	62200	89600	320000	390400	
15. Losses due to evaporation (m.a.ft.)	0.08	0.10	0.25	0.36	1.03	1.23	
16. Reserve for flood control	..	..	..	..	..	..	
17. Net storage available	1.63	1.34	2.05	3.14	14.60	21.00	
18. Continuous regulated discharge (cusecs)	3275	2380	9700	4140	20500	28980	
19. R. L. of the top of dead storage	1613	1638	1308	1147	790	470	
20. R. L. of tail race	1540	1585	1280	1125	670	375	
21. Average head available (feet)	141.5	106.5	50	47	168.5	155	
22. Continuous power available k. w.	30800	17500	32500	12700	223000	300000	
23. Gross area commanded (acres)	..	..	18,00,000	11,00,000	..	..	8,00,000

I.—Total live storage impounded . . 31.13 m. a. ft. Total gross area commanded 37,00,000 acres

II.—Continuous power generable Bilghara 30,800 K.W.

Ghugri 17,500 "

Bargi 32,500 "

Tawa 12,700 "

Punasa 223,000 "

At the dam between Punasa and Harinphal 112,000 "

Harinphal 250,000 "

At the two dams in the gorge . . . 320,000 "

Total . 9,98,500 "

G. N. PANDIT,  
Project Officer (Narbada and Tapti.)

## NARBADA PROJECTS ESTIMATES

Overall estimate for preliminary surveys and investigations in connection with projects for the multipurpose development of the Narbada Basin.

		Abstract	Rs.
I. WORKS.—			
1. Dams and Appurtenant works			
A. Preliminary expenses	. . . . .		8,74,000
K. Buildings	. . . . .		1,00,000
2. Main canal and Branches	. . . . .		45,46,500
3. Discharge and silt observations	. . . . .		2,00,000
4. Meteorological Observations	. . . . .		25,800
5. Mineral surveys	. . . . .		10,000
6. Surveys for Pisciculture	. . . . .		2,000
7. Malaria surveys	. . . . .		5,000
8. Electric Load surveys	. . . . .		10,000
9. Surveys for Navigation	. . . . .		1,00,000
10. Economic and property surveys	. . . . .		60,000
11. Soil erosion surveys	. . . . .		7,500
12. Communications	. . . . .		3,00,000
13. Special Tools and Plant	. . . . .		4,60,000
			<hr/>
			67,00,800
2 per cent. Contingencies	. . . . .		1,34,016
			<hr/>
		Total Works	68,34,816
			<hr/>
II. TOOLS AND PLANT—			
Tools and Plant for the Divisions	. . . . .		4,38,000
2 per cent. Contingencies	. . . . .		8,760
			<hr/>
		Total Tools and Plant	4,46,760
			<hr/>
III. ESTABLISHMENT			
Establishment for 4 years including establishment contingencies	. . . . .		23,09,568
			<hr/>
		Grand Total	95,91,144
			<hr/>

## I. WORKS

## Details

## Dams and Appurtenant Works

## A. Preliminary expenses

1. Survey of reservoir basins by air photography and ground survey and plotting contours at 10 ft.—5 ft. intervals on a scale of 4"—1 mile.

1. Ghugri Dam	. . . . .	50	sq. miles
2. Bilghra.	. . . . .	25.8	,,
3. Bargi	. . . . .	97	,,
4. Tawa	. . . . .	139	,,
5. Hoshangabad	. . . . .	25 (Approx.)	
6. Punasa	. . . . .	500	,,
7. Harinphal	. . . . .	140	,,
8. Dam site between Punasa and Harinphal	. . . . .	25	,,
9. 2 Dam sites in Rajpipla gorge	. . . . .	15	,,
		15	,,
		<hr/>	
		1031.8	

1031.8 S. miles at Rs. 375 per sq. mile

Rs. 3,87,000.

2. Survey of Dam sites and Weir sites by air photography and ground surveys and plotting on a scale of 32"=1 mile.

7500 acres at Rs. 4 per acre Rs. 30,000

3. Geological investigations for foundations of Dam sites and Weir sites and of the reservoir basins by boring, core drilling, making drifts and tunnelling etc. including testing. No. of bores

Bilghara	. . . . .	40 Nos.
Ghugri	. . . . .	56 ,,
Bargi	. . . . .	52 ,,
Tawa	. . . . .	30 ,,
Punasa	. . . . .	100 ,,
Harinphal	. . . . .	20 ,,
Hoshangabad	. . . . .	32 ,,
Dam site between Punasa and Harinphal	. . . . .	27 ,,
2 Dam sites in Rajpipla gorge	. . . . .	50 ,,
Pick up Weir for Broach project	. . . . .	25 ,,
		<hr/>

21,600 R. Ft. at Rs. 20 per R.Ft. —

432 Nos. each 50' in depth.  
Rs. 4,32,000.

4. Soil analysis and bororow surveys for earthen dams including testing . . . . .	L. S.	Rs. 10,000
5. Model Experiments by Indian Waterways Station Poona . . . . .	L. S.	15,000
<i>K. Buildings</i>		
Temporary buildings—10 sites . . . . .	L. S.	1,00,000
		9,74,000

## II. Main Canals and Branches.

(a) Survey of the commanded areas for alignments of canals		
Canals ex-Bargi . . . . .		18,00,000 acres.
Canals ex-Tawa . . . . .		11,00,000 „
Canals ex-Broach . . . . .		10,00,000 „
		39,00,000 acres.
39,00,000 acres @ Rs. 1/2 per acre.— . . . . .		Rs. 43,87,500
(b) Miscellaneous surveys . . . . .	L. S.	20,000
(c) Explorations for foundations of cross Drainage works and necessary surveys L.S. . . . .		1,00,000
(d) Soil surveys 39,00,000 acres at Rs. 11 per 100 acres . . . . .		39,000
		45,46,500

## III. Discharge and Silt Observations (Period 4 years)

One boatman and four Khalasis at each discharge site and cost of ropes, discharge rods, floats, gauges, silt samplers and laboratory equipment		
10 sites (8 on the Narbada and 2 at Tawa and Burhner) at Rs. 5,000 per site per year . . . . .		2,00,000

## IV. Meteorological Observations, Raingauges, Temperatures, Humidity and wind velocity Observations.

Equipment and installations of 15 new raingauges some of these to be of the integrated self-recording Type Humidity and wind velocity apparatus at 8 stations at an average rate of Rs. 1,000 . . . . .		15,000
Recurring Expenditure on part time observers		
15 observers at Rs. 15 p.m. for 4 years . . . . .		10,800
		25,800

V. Mineral Surveys L. S. . . . .		10,000
VI. Survey for Pisciculture L. S. . . . .		2,000
VII. Malaria Surveys L. S. . . . .		5,000
VIII. Electric load Surveys L. S. . . . .		10,000
IX. Surveys for Navigation L. S. . . . .		1,00,000
X. Economic and Property Surveys L. S. . . . .		60,000
XI. Surveys for soil Erosion L. S. . . . .		7,500

## XII. Communications

Constructing 100 miles of temporary roads and their maintenance for 2 years at Rs. 3000 per mile . . . . .		3,00,000
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## XIII. Special Tools and Plant.

6 Diamond drills complete with accessories at Rs 60,000 each . . . . .		3,60,000
Testing apparatus and laboratory and workshop equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture content and consolidation etc. L.S. . . . .		1,00,000
		4,60,000
		67,00,800
2% Contingencies . . . . .		1,34,016
Total Works . . . . .		68,34,816

## II. TOOLS AND PLANT.—

1. Motor vehicles for survey parties . . . . .		..
14 vehicles at Rs. 7,000 each . . . . .		98,000
Working expenses for four years . . . . .		1,40,000
2. Scientific Instruments . . . . .		1,20,000
3. Ordinary Tools and Plant . . . . .		10,000
4. Camp equipage . . . . .		30,000
5. Office furniture . . . . .		40,000
		4,38,000
2% Contingencies . . . . .		8,760
Total Tools and Plant . . . . .		4,46,760

## III. ESTABLISHMENT

		Expenditure per year	
		Rs.	
1. Pay of Officers			
Executive Engineers 2 Nos. @ Rs.875- p.m.			21,000
Assistant Executive Engineers 4 Nos. @ Rs.600 p.m.			28,800
Assistant Engineers 4 Nos. @ Rs.560-p.m.			26,880
Geologist 1 No. @ Rs.875 p.m.			10,500
Assistant Geologists 2 Nos. @ Rs.500 p.m.			12,000
Officer to conduct economic surveys 1 No. @ Rs. 550 p.m.			6,600
Drill Foreman 1 No. @ Rs. 1,000 p.m.			12,000
			<u>1,17,780</u>
2 Pay of Establishment		Rs.	
3 Meteorological Assistants @ Rs. 240 p.m.			8,640
2 Accountants @ Rs. 200 p.m.			4,800
2 Head clerks @ Rs. 180 p. m.			4,320
6 Senior clerks @ Rs. 150 p.m.			10,800
2 Storekeepers. @ Rs. 150 p.m.			3,600
14 Junior clerks @ Rs. 93 p.m.			15,624
2 Senior Draftsmen @ Rs. 200 p.m.			4,800
4 Junior Draftsmen @ Rs. 143 p.m.			3,432
4 Tracers @ Rs. 104 p.m.			4,992
2 Sub Assistant Surgeons @ Rs. 170 p.m.			4,080
2 Compounders @ Rs. 50 p.m.			1,200
32 Overseers @ Rs. 240 p.m.			92,160
6 Research Assistants @ Rs. 240 p.m.			17,280
2 Laboratory Assistants @ Rs. 230 p.m.			5,520
2 Silt Analysts @ Rs. 200 p.m.			4,800
2 Assistant silt Analysts @ Rs. 93 p.m.			2,232
10 Gauge readers @ Rs. 70 p.m.			8,400
10 Senior Observers @ Rs. 90 p.m.			10,800
2 Dafadars @ Rs. 33 p.m.			792
10 Barkandaz @ Rs. 33 p.m.			3,960
14 Peons @ Rs. 33 p.m.			5,544
6 Laboratory Khalasis @ Rs. 33 p.m.			2,376
10 Chowkidars @ Rs. 33 p.m.			3,960
		Total	<u>2,24,112</u>
3. Dearness allowance of Officers			16,020
4. Dearness allowances for establishment			66,480
5. Travelling allowance for Officers			40,000
6. Travelling allowances for establishment			60,000
7. Cost of project Circle office debited to Narbada			33,000
8. Establishment contingencies			20,000
		Establishment per year	<u>5,77,392</u>
Grand Total Establishment for 4 years			<u>23,09,568</u>

G. N. Pandit,  
Project Officer (Narbada & Tapti).

*II. Estimate for preliminary surveys and investigations in connection with projects for multipurpose development in the Basin of the Narbada River for the year 1947-48 submitted to Government for sanction.*

**I. WORKS**

**Dams and appurtenants works**

(i) Preliminary expenses	
(ii) Survey to be carried out by the survey of India Department . . . . .	L. S. Rs. 2,500
1. Survey to be carried out by or under the directions of C. W. I. N. C. . . . .	L. S. . .14,000
2. Discharge and silt observations . . . . .	L. S. ., 1,990
3. Geological investigations and mineral surveys . . . . .	L. S. ., 1,000
4. Communications . . . . .	L. S. .10,000
5. Contingencies at 2 per cent. . . . .	650
<b>Total Works</b> . . . . .	<b>Rs. 30,140</b>

**II. TOOLS AND PLANT.—**

*(Including transport conveyance and its carriage and repair charges survey and mathematical instruments camp equipage silt observation apparatus etc.)*

(a) New Supplies	Rs.
9 Weapon carriers at Rs. 7000 each . . . . .	63,000
3 Jeeps with trailers at Rs. 7000 each. . . . .	21,000
2 Chronographs at Rs. 100 each . . . . .	200
2 current meters @ Rs. 1000 each . . . . .	2,000
2 large boats @ Rs. 1000 each . . . . .	2,000
2 small boats @ Rs. 500 each . . . . .	1,000
Discharge rods . . . . .	200
Sounding rods . . . . .	100
Ropes . . . . .	500
One set of apparatus for silt observations @ Rs.1,500 each and remaining laboratory equipment . . . . .	2,200
(b) Repairs and Carriage	
Repairs to trucks etc.. . . . .	1,500
<b>Grand Total of Tools and Plant</b> . . . . .	<b>93,700</b>

**III. ESTABLISHMENT—**

*(a) Pay of Officers*

2 Executive Engineers for 3 months @ Rs. 900 p.m. . . . .	5,400
4 Assistant Engineers for 3 months @ Rs. 350 p.m. . . . .	4,200
1 Geologist for 3 months @ Rs. 600 p.m. . . . .	1,800
<b>Total</b> . . . . .	<b>11,400</b>

*Pay of establishment.—*

11 Overseers for 3 months @ Rs. 180 p.m. . . . .	5,940
2 Accountants for 3 months @ Rs. 200 p.m. . . . .	1,200
2 Head clerks for 3 months @ Rs. 160 p.m. . . . .	960
1 Sub Assistant Surgeon for 2 months @ Rs. 200 p.m. . . . .	400
3 clerks for 3 months @ Rs.80 p.m. . . . .	720
4 Sub Divisional clerks for 3 months @ Rs. 75 p.m. . . . .	900
1 Head Draftsman for 3 months @ Rs. 250 p.m. . . . .	750
2 Junior Draftsmen for 3 months @ Rs.100 p.m. . . . .	600
4 Tracers for 3 months @ Rs. 80 p.m. . . . .	960
1 Dispenser for 2 months @ Rs. 80 p.m. . . . .	160
1 Daffadar for 2 months @ Rs. 35 p.m. . . . .	7
3 Barkandaz for 3 months @ Rs. 30 p.m.. . . . .	27
7 Peons for 3 months @ Rs.30 p.m.. . . . .	630
4 Peons for 3 months @ Rs. 30 p. m. . . . .	360
5 Chowkidars for 3 months @ Rs. 30 p.m. . . . .	450
4 Dak runners for 3 months @ Rs. 30 p.m. . . . .	360
11 Khalasis for overseers for 3 months @ Rs. 30 p.m. . . . .	990
7 Gauge readers for 3 months @ Rs. 30 p.m. . . . .	630
Geologist—staff—L.S. . . . .	1,000
	<b>17,850</b>

Dearness allowance and Special pay of Officers L.S. . . . .	1,180
Dearness allowance of establishment . . . . . L.S.	7,000

*Travelling allowance for officers—*

1. Executive Engineers . . . . .	1,400
2. Assistant Engineers . . . . .	1,800
3. Geologists . . . . .	1,000
	<b>4,200</b>

**Travelling Allowance of Establishment**

Supervisors . . . . .	2,000
Other staff (Executive Engineers) . . . . .	2,000
Geologist—Other Staff . . . . .	400
	<hr/>
	4,400
	<hr/>

**(b) Establishment Contingencies.—**

Rent for Divisional and Sub Divisional Offices . . . . .	1,000
Rent for Geologists' Offices . . . . .	400
	<hr/>

Grand total of establishment . . . . .	46,900
I. Works . . . . .	30,140
II. Tools and Plant . . . . .	93,700
III. Establishment . . . . .	46,900
	<hr/>
Total . . . . .	1,70,740
	<hr/>

G. N. PANDIT,  
Project Officer, (Narhada and Tapti.)

*III. Estimate for the Preliminary surveys and investigation in connection with the project for multipurpose developments in the Basin of the Narbada River for the year 1948-49, submitted to Government for sanction.*

**I. Works**

1. <i>Dams and appurtenant works.</i> —A Preliminary expenses.		Rs.
Survey to be carried out by the survey of India	L.S.	3,00,000
Survey to be carried out by or under the direction of C.W.I.N.C.	L.S.	20,000
K. Buildings	L.S.	50,000
2. <i>Main canal and branches.</i> —		
Miscellaneous surveys such as canal alignments, special reservoir surveys etc.	L.S.	40,000
Soil surveys	L.S.	70,000
3. <i>Meteorological surveys.</i> —		
Rain gauges—It is proposed to install 70 new rain gauges (i) Equip- ment and installation of gauges—70 new rain gauges including temperature, humidity and wind velocity apparatus at 35 places and some self-recording gauges at an average rate of Rs. 500 each		35,000
(ii) Observation Expenditure per year		
3 Meteorological Assistants @ Rs. 200 p. m.		7,200
3 Senior Observers @ Rs. 120 p. m.		4,320
70 part time Observers @ Rs. 15 p.m.		12,600
70 Part time Retainers @ Rs. 12 p.m.		10,080
		<hr/>
	34,220	69,000
		(say)
5 Geological investigations and mineral surveys	L.S.	20,000
6 Communications	L.S.	50,000
7 Special Tools and Plant (Drill equipment and apparatus for soil laboratory.)	L.S.	12,00,000
8 Economic surveys	L.S.	6,000
9 Hydro Electric Installations—A preliminary expenses Electric Load surveys	L.S.	5,000
10 Contingencies @ 2%		61,000
		<hr/>
Total Works		19,41,000

**II. Tools and Plant—**

7 country boats @ Rs. 1000 each	7,000
3 outboard motors @ Rs. 1000 each	3,000
16 chronographs at Rs. 100 each	1,600
18 levelling instruments at Rs. 800 each	14,400
3 theodolites at Rs. 1500 each	4,500
3 Binoculars at Rs. 200 each	600
1 camera at Rs. 600	600
18 measuring chains @ Rs. 15 each	270
60—100 ft. tapes at Rs. 30 each	1800
60—50 ft. tapes at Rs. 20 each	1,200
7 steel tapes @ Rs. 100	700
7 drawing boards at Rs. 30 each	210
7 2nd class drawing instrument boxes @ Rs. 200 each	1,400
2 first class drawing instrument boxes @ Rs. 300 each	600
Scales with offsets, etc. french curves and miscellaneous scientific instruments and tools and plant	1,00
10 current meters @ Rs. 1000 each	10,000
10 large boats at Rs. 1000 each	10,000
10 small boats at Rs. 500 each.	5,000
Discharge rods	2,300
Sounding rods	1,100
Ropes.	2,500
1 set of apparatus for silt observations	1,500
Recurring laboratory expenses	300
15 Nos. 14' × 14' tents @ Rs. 1200 each	18,000
40 Nos. 10' × 10' tents @ Rs. 800 each.	32,000
40 Nos. shouldaries at Rs. 600 each.	24,000
40 servants' tents at Rs. 500 each	20,000
Camp furniture	58,000
Office furniture for Divisional and Sub-Divisional offices	15,000
Office furniture for soil physicist office and laboratory	2,500
Office furniture for geologist office	2,500
Repairs and Carriage — yearly repairs to trucks	5,420
Contingencies at 2%	4,000
	<hr/>
Total Tools and Plant	2,00,000



III.—*Establishment.*—(a) *Pay of officers.*—

2 Executive Engineers at Rs. 900 p.m. for 12 months	21,600
3 Assistant Engineers at Rs. 350 p.m. for 12 months	23,600
1 Geologist at Rs. 600 p.m. for 12 months	7,200
2 Assistant Geologists at Rs. 400 p.m. for 12 months	9,600
1 Soil Physicist at Rs. 275 p.m. for 12 months	3,300

75,300

(b) *Pay of establishment.*—

32 overseers at Rs. 180 p.m. for 12 months	69,120
2 Accountants at Rs. 200 p.m. for 12 months	4,800
2 head clerks at Rs. 160 p.m. for 12 months	3,840
2 sub asstt. surgeons at Rs. 200 p.m. for 12 months	4,800
10 clerks at Rs. 80 p.m.	9,600
16 Sub Divisional clerks at Rs. 75 p.m. for 12 months	14,400
2 Head draftsmen for 12 months at Rs. 250 p.m.	6,000
2 Junior draftsmen for 12 months at Rs. 100 p.m.	2,400
4 tracers for 12 months at Rs. 80 p.m.	3,840
2 dispensers for 12 months at Rs. 80 p.m.	1,920
2 daffadars for 12 months at Rs. 35 p.m.	840
10 barkandaz for 12 months at Rs. 30 p.m.	3,600
22 peons for 12 months at Rs. 30 p.m.	7,920
12 peons for 12 months at Rs. 30 p.m.	4,320
10 chowkidars for 12 months at Rs. 30 p.m.	3,600
12 Dak runners for 12 months at Rs. 30 p.m.	4,320
32 khalasis for overseers for 12 months at Rs. 30 p.m.	11,520
20 gauge readers for 12 months at Rs. 30 p.m.	7,200
Geologist staff L.S.	4,000
6 sub overseers at Rs. 50 p.m. for 12 months	3,600
3 Laboratory assistants at Rs. 100 p.m. for 12 months	3,600
2 clerks at Rs. 40 p.m. for 12 months	960
1 computer at Rs. 40 p.m. for 12 months	480
1 tracer at Rs. 40 p.m. for 12 months	480
3 laboratory peons at Rs. 25 p.m. for 12 months	900
2 peons at Rs. 25 p.m. for 12 months	600
1 Tapali at Rs. 25 p.m. for 12 months	300
4 Auger measurers at Rs. 40 p.m. for 12 months	1,920

1,80,880

Dearness allowance and special pay of officers

26,420

Dearness allowance of establishment L.S.

73,000

Travelling allowance of officers :—

Rs.

Executive Engineers.	5,800
Asstt. Engineers	14,400
Geologists	8,000
Asstt. Geologists	9,000
Soil Physicist	5,000

42,200

Travelling allowance of establishment

Supervisors	28,000
Other staff XEN's	10,000
Other staff (Geologist)	1,600

Soil survey staff.—

Sub overseers	2,000
Auger measurers	2,000
Other staff	2,000

(c) *Establishment contingencies.*—

Rent for Divnal and Sub. Divl. offices	4,000	45,600
Rent for soil physicist's office and lab.	1,000	
Rent for Geologist's office	1,600	6,600

Total Establishment

4,50,000

*Abstract.*—

I. Works	19,41,000
II. Tools and Plant	2,00,000
III. Establishment	4,50,000
Grand Total	25,91,000

G. N. PANDIT  
Project Officer,  
Narbada and Tapti.

IV.—*Estimate for preliminary surveys and investigations in connection with Projects for the multi-purpose developments of the Narbada Basin Prepared in accordance with the instructions of the ad hoc Committee.*

Rs.

*Abstract—*

1. Bargi Project . . . . .	27,39,114
2. Tawa Project . . . . .	15,42,677
3. Punasa Project . . . . .	7,35,329
4. Broach Project . . . . .	11,02,255
5. General Surveys . . . . .	3,77,70
Total . . . . .	64,97,081
Say Rs. . . . .	64,97,000

*Estimate for the preliminary surveys and investigations for dam sites on the Narbada at Bilgarha and Bargi and on the Burhner River at Ghugri and a canal system taking off from Bargi .*

*Abstract—*

## I. WORKS.—

1 Dams and appurtenant works—	
A. Preliminary expenses . . . . .	2,35,800
K. Buildings . . . . .	30,000
2. Main Canals and Branches . . . . .	10,98,500
3. Malaria Surveys . . . . .	1,000
4. Electric Load Surveys . . . . .	2,000
5. Property Surveys . . . . .	7,500
6. Communications . . . . .	1,00,000
7. Special Tools and Plant . . . . .	1,60,000
	16,34,800
2% contingencies . . . . .	32,696
	16,67,496

II. TOOLS AND PLANT . . . . . 2,05,530

III. ESTABLISHMENT . . . . . 8,66,088

Total . . . . . 27,39,114

*Details*

## I. WORKS—

1. *Dams and appurtenant works.—*A. *Preliminary Expenses.—*

1. Survey of Reservoir basins by air photography and ground survey and plotting of contours at 10 ft.—5 ft. intervals on a scale of 4"—1 mile.

Ghugri dam . . . . .	50 sq. miles
Bilghara . . . . .	25.8 sq. miles
Bargi . . . . .	97 sq. miles
	172.8 sq. miles

Rs.

172.8 sq. m. at Rs. 375 per sq. mile . . . . . 65,000

2. Survey of dam sites by air photography and ground survey and plotting on a scale of 32"—1 mile. 2,700 acres at Rs. 4 per acre . . . . . 10,800

3. Geological investigations for foundations

## No. of bores.—

Bilghara . . . . .	40 Nos.
Ghugri . . . . .	56 Nos.
Bargi . . . . .	52 Nos.
	148 Nos.

148 bores each 50 rft. at Rs. 20 per rft. . . . . 1,48,000

4. Soil analysis and burrow surveys . . . . . L.S. 7,000

5. Model experiments . . . . . L.S. 5,000

2,35,800

K. *Buildings.—*

Temporary Buildings . . . . . L.S. 30,000

II. *Main canals and branches.—*

(a) Survey of commanded area 18,00,000 acres at (As-/-) per acre. . . . . 10,12,500

(b) Miscellaneous surveys . . . . . L.S. 8,000

(c) Exploration for founds of cross drainage works . . . . . 60,000

(d) Soil surveys 18,00,000 acres at Re. 1 per 100 acres . . . . . 18,000

10,98,500

Rs

III. Malaria surveys . . . . .	1,000
IV. Electric load surveys . . . . .	2,000
V. Property surveys 173 sq. miles at Rs. 43 per sq. mile . . . . .	7,500
VI. Communications . . . . .	1,00,000
VII. Special Tools and Plant . . . . .	..
2 Diamond drills . . . . .	1,20,000
Testing apparatus . . . . .	40,000
	<hr/>
	1,60,000

## II. TOOLS AND PLANT.

Motor vehicles 7 vehicles at Rs. 7,000 . . . . .	49,000
Working expenses for 3 years . . . . .	52,500
Scientific Instruments . . . . .	60,000
Ordinary Tools and Plant . . . . .	5,000
Camp equipage . . . . .	15,000
Office furniture . . . . .	20,000
	<hr/>
	2,01,500
2 % contingencies . . . . .	4,030
	<hr/>
	2,05,530

## III. ESTABLISHMENT:

Cost of 1 Division for 3 years at Rs. 2,88,696 per year . . . . .	8,66,088
	<hr/>

2. Estimate for the preliminary surveys and investigations for a dam site on the Tawa River, and a left bank canal taking off from the dam for purposes of irrigation.

## Abstract

## I. WORKS.—

## 1. Dams and appurtenant works—

A. Preliminary expenses— . . . . .	87,125
K. Buildings . . . . .	25,000
2. Main canals and branches . . . . .	6,59,750
3. Malaria surveys . . . . .	1,000
4. Electric load surveys . . . . .	500
5. Property surveys . . . . .	6,000
6. Communications . . . . .	80,000
7. Special Tools and Plant . . . . .	1,35,000
	<hr/>
	9,94,375
2 % contingencies . . . . .	19,888
	<hr/>

Total Works . . . . .	10,14,263
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II. TOOLS AND PLANT . . . . .	95,370
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III. ESTABLISHMENT . . . . .	4,33,044
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Total . . . . .	<hr/>
	15,42,677

## Details

## I. WORKS—

## 1. Dams and appurtenant works.—

## A. Preliminary Expenses—

1. Survey of reservoir basin by air photography and ground survey and plotting contours at 10 ft.—5 ft. intervals on a scale of 4" — 1 mile 139 sq. miles at Rs. 375 per sq. mile . . . . .	52,125
2. Survey of dam site by air photography and ground survey and plotting on a scale of 32" — 1 mile 500 acres at Rs. 4 per acre . . . . .	2,000
3. Geological investigations for foundations of dam and reservoir basin by boring, core drilling, making drifts, tunnelling etc. including testing 30 Nos. bores each of 50 Rft. at Rs. 20 per Rft. . . . .	30,000
4. Soil surveys and burrow surveys . . . . . L.S.	1,000
5. Model experiments by Indian Waterways Station, Poona . . . . .	2,000
	<hr/>

## K. Buildings.—

Temporary buildings . . . . . L.S.	25,000
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## 2. Main Canals and Branches.—

1. Survey of the commanded area for Canal alignment 11,00,000 acres at Rs. 9 per acre . . . . .	6,18,750
2. Miscellaneous surveys . . . . . L.S.	5,000
3. Explorations for foundations of cross drainage works and necessary surveys . . . . . L.S.	25,000
4. Soil surveys 11,00,000 acres at Rs. 1 per 100 acres . . . . .	11,000
	<hr/>
	6,59,750

3. Malaria Surveys . . . . .	L.S.	Rs. 1,000
4. Electric load survey . . . . .	L.S.	500
5. Property surveys 139 sq. miles at Rs. 43/- per sq. mile . . . . .		6,000
6. Communications		
Constructing and maintaining for 3 years temporary roads . . . . .	L.S.	30,000
7. Special Tools and Plant		
1. 2 Diamond drills complete with accessories at Rs. 60,000 each . . . . .		1,20,000
2. Testing apparatus and laboratory equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture content and consolidation etc. . . . .	L.S.	15,000
		<u>1,35,000</u>
2 % contingencies . . . . .		9,94,375
		<u>19,888</u>
Total Works . . . . .		<u>10,14,263</u>

## II. TOOLS AND PLANT.—

1. Motor vehicles for survey parties 3 Nos. at Rs. 7,000 each . . . . .	21,000
2. Working expenses for above for 3 years . . . . .	22,500
3. Scientific Instruments . . . . .	30,000
4. Ordinary Tools and Plant . . . . .	2,500
5. Camp equipage . . . . .	7,500
6. Office furniture . . . . .	10,000
	<u>93,500</u>
2% contingencies . . . . .	1,870
	<u>95,370</u>

## III. ESTABLISHMENT.—

Cost of 1 Division for 3 years—8,66,088. 50% chargeable to Tawa . . . . .	<u>4,33,044</u>
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3. Estimate for the preliminary surveys and investigations for a dam site on the Narbada River near Punasa, for purposes of flood control and generating hydro-electric power.

### Abstract

#### I. WORKS.—

1. Dams and appurtenant works	Rs.
A. Preliminary Expenses . . . . .	3,04,500
K. Buildings . . . . .	30,000
2. Malaria surveys . . . . .	3,000
3. Electric load surveys . . . . .	7,500
4. Property surveys . . . . .	21,500
5. Communications . . . . .	1,00,000
6. Special Tools and Plant . . . . .	1,45,000
	<u>6,11,500</u>
2 % contingencies . . . . .	12,250
	<u>6,23,750</u>
Total Works . . . . .	24,990

#### II. TOOLS AND PLANT

#### III. ESTABLISHMENT

Total . . . . .	<u>7,35,329</u>
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### Details

#### I. WORKS.—

##### 1. Dams and appurtenant works

##### A. Preliminary Expenses—

1. Survey of Reservoir basin by air photography and ground survey and plotting contours at 10 ft. —5 ft. intervals on a scale of 4" = 1 mile 500 sq. miles at Rs. 375 per sq. mile. . . . .	1,87,500
2. Survey of dam site by air photography and ground survey and plotting on a scale of 32" = 1 mile, 2000 acres at Rs. 4 per acre . . . . .	8,000
3. Geological Investigations for foundations of dam site and reservoir basin by boring core drilling, making drifts, tunnelling etc. including testing 100 Nos. bores each 50' deep = 5,000 Rft. at Rs. 20 per Rft. . . . .	1,00,000
4. Soil analysis and burrow surveys for earthen dykes including testing . . . . .	L.S. 2,000
5. Model Experiments by Indian Waterways Station, Poona . . . . .	L.S. 7,000
	<u>3,04,500</u>

	Rs.
<b>K. Buildings.—</b>	
Temporary Buildings . . . . . L.S. .	30,000
2. Malaria Surveys . . . . . L.S. .	3,000
3. Electric load surveys . . . . . L.S. .	7,500
4. Property surveys 500 sq. miles at Rs. 43 per sq. m. . . . .	21,500
5. <i>Communications</i> . . . . . L.S. .	1,00,000
Constructing temporary roads and their maintenance for 3 years. . . . .	
6. <i>Special Tools and Plant.—</i>	
1. 2 diamond drills complete with accessories at Rs. 60,000 each . . . . .	1,20,000
2. Testing apparatus for Laboratory and workshop equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture content and consolidation, etc. . . . . L.S. .	25,000
	1,45,000
	6,11,500
	12,230
2% contingencies . . . . .	
Total Works . . . . .	6,23,730

## II. TOOLS AND PLANT.—

Motor vehicle for survey party 1 No. at Rs. 7000 . . . . .	7,000
Working expenses for 3 years . . . . .	7,500
Scientific instruments . . . . .	6,000
Ordinary Tools and Plant . . . . .	500
Camp equipage . . . . .	1,500
Office furniture . . . . .	2,000
	24,500
2% contingencies . . . . .	490
	24,990

## III. ESTABLISHMENT.—

Cost of 1 Division for 3 years—8,66,088. 10% chargeable to Punasa . . . . .	86,609
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4. *Estimate for preliminary surveys and Investigations for the Broach Project consisting of a Pick-up Weir at the end of the Rajpipla Gorge, and left and right bank canals taking off from the weir for purposes of irrigation.*

### Abstract

#### I. WORKS.—

1. Dams and Appurtenant works	Rs.
A. Preliminary Expenses . . . . .	28,000
K. Buildings . . . . .	15,000
2. Main Canals and Branches . . . . .	5,94,500
3. Communications . . . . .	20,000
	6,57,500
2% contingencies . . . . .	13,150
Total Works . . . . .	6,70,650

II. TOOLS AND PLANT . . . . .	85,170
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III. ESTABLISHMENT . . . . .	3,46,435
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Total . . . . .	11,02,255
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### Details

#### I. WORKS.—

##### 1. Dams and appurtenant works.—

##### A. Preliminary Expenses.—

1. Survey of weir site by air photography and ground surveys and plotting on a scale of 32"=1 mile, 500 acres at Rs. 4 per acre . . . . .	2,000
2. Geological Investigations for foundation of weir site by boring, core drilling etc. including testing. 25 Nos. bores, each of depth 50'—1,250 Rft. at Rs. 20 per Rft. . . . .	25,000
3. Model Experiments by Indian Waterways, Station, Poona . . . . . L.S. .	1,000
	28,000

##### K. Buildings.—

Temporary Buildings . . . . . L.S. .	15,000
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##### 2. Main Canals and Branches.—

1. Survey of commanded areas for alignments of canals, 10,00,000 acres at Rs. 5 per acre . . . . .	5,62,500
2. Miscellaneous surveys . . . . . L.S. .	7,000
3. Explorations for foundations of cross-drainage works and necessary surveys . . . . . L.S. .	15,000
4. Soil surveys, 10,00,000 acres at Rs. 1/4 per 100 acre . . . . .	10,000
	5,94,500

3. *Communications—*

	Rs.
Constructing temporary roads and maintaining them for 3 years . . . L. S. .	26,000
2% contingencies . . . . .	6,57,500
	13,150
<b>Total Works.</b> . . . .	<b>6,70,650</b>

II. *TOOLS AND PLANT—*

Motor vehicles for survey parties 3 Nos. at Rs. 7,000 each . . . . .	21,000
Working expenses for 3 years . . . . .	22,500
Scientific Instruments . . . . .	24,000
Ordinary Tools and Plant . . . . .	2,000
Camp equipage . . . . .	6,000
Office furniture . . . . .	8,000
2% contingencies . . . . .	83,500
	1,670
	<b>85,170</b>

III. *ESTABLISHMENT—*

Cost of 1 Division for 3 years 8,66,088. 40% chargeable to Broach Project . . . .	3,46,435
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5. *Estimate for the general investigations and surveys in the whole basin in connection with Projects for the Multi-purpose Development of the Narbada Basin.*

*Abstract*I. *WORKS—*

	Rs.
1. Discharge and Silt Observations . . . . .	2,00,000
2. Meteorological Observations . . . . .	25,800
3. Mineral Surveys . . . . .	10,000
4. Surveys for Pisciculture . . . . .	2,000
5. Surveys for Navigation . . . . .	1,00,000
6. Economic Surveys] . . . . .	25,000
7. Surveys for soil erosion . . . . .	7,500
2% contingencies . . . . .	3,70,300
	7,406
<b>Total</b> . . . . .	<b>3,77,706</b>

*Details*I. *WORKS. —*1. *Discharge and silt observations.—*

One boatman and four khalasis at each discharge site, and cost of ropes, discharge rods, floats, gauges, silt samplers, and laboratory equipment

10 sites (8 on Narbada and 2 at Tawa and Buihner) at Rs. 5,000 per site per year for 4 years . . . . .	2,00,000
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2. *Meteorological Observations (Rain gauge)—*

Raingauges Temperature, humidity, and wind velocity observations.

(i.) Equipment and installation of 15 new rain gauges (some of these to be of the integrated self-recording type) humidity and wind velocity apparatus at 5 stations at an average rate of Rs. 1,000 . . . . .	15,000
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(ii.) Recurring expenditure on part-time observers. 15 observers at Rs. 15 p.m. for 4 years . . . . .	10,800
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2,25,800

3. Mineral Surveys . . . . . L.S. .	10,000
4. Surveys for Pisciculture . . . . . L.S. .	2,000
5. Surveys for Navigation . . . . . L.S. .	1,00,000
6. Economic Surveys . . . . . L.S. .	25,000
7. Surveys for soil erosion . . . . . L.S. .	7,500

2% contingencies . . . . .	3,70,300
	7,406

<b>Total Works</b> . . . . .	<b>3,77,706</b>
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*Details of the establishment of the two Divisions provided for in the preceding five estimates.*

1. Pay of Officers	Details of establishment of the two Divisions	Expenditure per year Rs.
2 Executive Engineers @ Rs. 875 p.m. .		21,000
4 Asstt. Executive Engineers @ Rs. 600 p.m.		28,800
4 Asstt. Engineers @ Rs. 560 p.m. . . .		26,880
1 Geologist @ Rs. 875 p.m. . . . .		10,500
2 Asstt. Geologists @ Rs. 500 p.m. . . .		12,000
1 Officer to conduct economic surveys @ Rs 550 p.m.		6,600
1 Drill Foreman @ Rs. 1000 p. m. . . .	1 No. at Rs. 1,000 p.m.	12,000
		<hr/> 1,17,780
2. Pay of Establishment.		
3 Meteorological Asstts. @ Rs. 240 p.m. .		8,640
2 Accountants @ Rs. 200 p.m. . . . .		4,800
2 Head Clerks @ Rs. 180 p.m. . . . .		4,320
6 Senior Clerks @ Rs. 150 p.m. . . . .		10,800
2 Storekeepers @ Rs. 150 p.m. . . . .		3,600
14 Junior Clerks @ Rs. 93 p.m. . . . .		15,624
2 Senior Draftsmen @ Rs. 200 p.m. . . .		4,800
2 Junior Draftsmen @ Rs. 143 p.m. . . .		3,432
4 Tracers @ Rs. 104 p.m. . . . .		4,992
2 Sub. Asstt. Surgeons @ Rs. 170 p.m. . .		4,080
2 Compounders @ Rs. 50 p.m. . . . .		1,200
32 Overseers @ Rs. 240 p.m. . . . .		92,160
6 Research Asstts. @ Rs. 240 p.m. . . .		17,280
2 Laboratory Asstts. @ Rs. 230 p.m. . . .		5,520
2 Silt Analysts @ Rs. 200 p.m. . . . .		4,800
2 Asstt. Silt Analysts @ Rs. 93 p.m. . . .		2,232
10 Gauge Readers @ Rs. 70 p.m. . . . .		8,400
10 Senior Observers @ Rs. 90 p.m. . . . .		10,800
2 Daffadars @ Rs. 33 p.m. . . . .		792
10 Barkandaz @ Rs. 33 p.m. . . . .		3,960
14 Peons @ Rs. 33 p.m. . . . .		5,544
6 Laboratory khalsis @ Rs. 33 p.m. . . .		2,376
10 Chowkidars @ Rs. 33 p.m. . . . .		3,960
		<hr/> 2,24,112
3 Dearness Allowance for officers . . . . .		16,020
4 Dearness Allowance for establishment . . . . .		66,480
5 T.A. for officers . . . . .		40,000
6 T.A. for establishment . . . . .		60,000
7 Cost of Project circle office debited to Narbada . . . . .		33,000
8 Establishment contingencies . . . . .		20,000
		<hr/> 5,77,392
Cost of establishment of 1 Division per year		
5,77,392		
<hr/>		
2		=2,88,696
Cost of 1 Division for 3 years Rs. 8,66,088		

G. N. PANDIT  
Project Officer,  
(Narbada and Tapti.)

## APPENDIX V

## TAPTI VALLEY PROJECTS

As in the case of the Narbada, no work for utilising the waters of the Tapti river has so far been executed. This river drains a total area of about 30,000 square miles and approximately 45 million acre feet of water precipitate in the basin during the monsoon months. The entire quantity runs to waste to the sea. The Surat plain often gets flooded causing a lot of damage to life and property. During the last 60 years as many as 15 floods have been reported within this area. The maximum discharge has been calculated to have reached the figure of 900,000 cusecs. Towards the end of the last century a proposal for irrigating lands in the Surat plain was investigated but the scheme did not materialise.

Government of Bombay approached CWINC about a year and a half ago with a request to investigate and formulate schemes which would mitigate the evil of flood and enable the water resources of the basin being utilised for such other beneficial purposes as irrigation, extension of navigation and generation of hydel power. Studies of topographical and hydrological data of the basin were accordingly taken up by the CWINC early in 1947. These studies have revealed that quite a number of suitable sites for development exist in the basin whereby construction of dams of low to medium heights reservoirs can be created for storage of water during monsoons, regulated discharges from which can be utilized for the multipurposes of irrigation and power generation. By allowing a reserve for flood absorption in the lowermost reservoir, floods in the Surat plain can be completely controlled.

For the present it has been decided to investigate only six projects of which four are on the main river and two on the tributaries. Another project on an important tributary Girna is being investigated by the Government of Bombay. Total storage at these sites will amount to about 4.5 million acre feet, slightly less than in the case of the Damodar Valley Projects. A gross area of 12,85,000 will be commanded for irrigation and 63,010 K.Ws. of continuous power generated. Such other benefits as fish culture in the reservoirs, recreational amenities and assurance of adequate domestic water supplies will also accrue to the entire basin with the development of these projects. A list of the projects as well as their details is appended to this note.

The estimate amounting to Rs. 42,25,034 has been prepared to cover the cost of necessary surveys and investigations in order to prepare the projects in detail for execution. It is proposed to set up one division with four subdivisions and requisite number of subordinates and ministerial staff to do the work. Details of the work to be done are shown in the estimate. Topographical surveys of the dam sites, reservoir areas, areas to be commanded for irrigation will be done through the agency of the Survey of India Department. Geological surveys of the dam sites and mineral surveys of the basin will be undertaken in collaboration of the Geological Survey of India. Hydrological surveys will similarly be done in close co-operation with the Indian Meteorological Department. Provisions have also been made for soil surveys of the area to be irrigated and such other items as electrical load surveys, malaria control surveys, fish culture survey and economic and property survey. Necessary staff for geological and other surveys has been provided. It is anticipated that a period of two years will be required to complete all these surveys and investigations. Accordingly staff has been provided for that period. Necessary tools and plant such as survey instruments, core drills, camp requisites have also been provided for.

A statement showing the rough data for the dam sites and the anticipated benefits from the projects is given on page (38). The following maps and charts are enclosed.

- (1) An index map of the Tapti basin showing the proposed dam sites and projects.
- (2) A profile of the Tapti river and its main tributaries.

G. N. Pandit,  
Project Officer. (Narbada & Tapti.)



*Tapti Basin—Rough Data for the Dam Sites*

	Tapti Atwadhana 91	Tapti Nawtha 259	Tapti Hatnur 315	Tapti Ukai 487	Waghur Bhagpur 44	Panjhra Akalpada 36
1. Name of the river						
2. Name of dam site						
3. Length along river (miles).						
4. Latitude and Longi- tude of dam site.	77° 20' 0" E 21° 49' 15" N	76° 27' 0" E 21° 26' 0" N	75° 57' 0" E 21° 3' 30" N	73° 35' 30" E 21° 15' 30" N	75° 42' 0" E 20° 56' 0" N	74° 28' 0" E 20° 57' 0" N
5. Catchment area above dam (sq. miles).	1,049	3,100	11,750	23,365	789	510
6. Average rainfall in catchment (inches).	43	41.88	34.42	30.37	30	30
7. Probable mean annual run off. (m. a. ft.)	0.92	1.4	2.5	3.43*	0.17	0.108
8. R. L. of river bed	1,190	800	625	175	730	1,170
9. Proposed F. T. L.	1,340	900	690	400	Not worked out.	
10. Maximum height of dam upto F. T. L. (ft.).	150	100	65	225	Not worked out.	
11. Length of dam at F. T. L. (ft.).	2,700	2,640	20,000	16,000	Not worked out.	
12. Gross capacity of re- servoir at F. T. L. (m. a. ft.).	0.82	0.56	..	6.19	Not worked out.	
13. Flood storage (m. a. ft.).	0.11	0.20	..	1.71	Not worked out.	
14. Maximum area of water spread (acres).	11,900	19,400	..	1,76,000	Not worked out.	
15. Losses due to evapo- ration (5.5 ft. per year) m. a. ft.	0.042	0.075	..	0.49	Not worked out.	
16. Reserve for flood con- trol (m. a. ft.).	..	..	..	1.05	Not worked out.	
17. Net Storage available (m. a. ft.).	0.67	0.28	..	2.94	Not worked out.	
18. Continuous regulated discharge (cusecs).	890	1,285	1,285	4,000	Not worked out.	
19. R. L. of top of dead storage.	1,252	875	..	360	Not worked out.	
20. R. L. of Tail Race	1,160	810	..	195	Not worked out.	
21. Average head available for power (ft.).	141	77.5	..	181	Not worked out.	
22. Continuous power available (k. w.).	8,360	6,650	..	48,000	Not worked out.	
23. Gross area commanded (acres)	..	..	5,00,000	7,00,000	50,000	35,000

\*Excluding run-off intercepted above.

- I Total live storage impounded . . . . . 4.497 m. a. ft.  
 II. Total continuous power generated . . . . . 63,010 k. w.  
 III. Total gross area commanded for irrigation . . . . . 12 85,000 acres

## Tapti Projects Estimates

### OVERALL ESTIMATE FOR PRELIMINARY SURVEYS AND INVESTIGATIONS IN CONNECTION WITH PROJECTS FOR THE MULTI-PURPOSE DEVELOPMENT OF THE TAPTI BASIN.

#### Abstract.

#### I. WORKS—

##### 1. Dams and Appurtenant works—

	Rs.
A. Preliminary expenses . . . . .	5,80,000
K. Buildings . . . . .	60,000
2. Main canals and Branches . . . . .	14,78,800
3. Discharge and Silt Observations . . . . .	1,40,000
4. Meteorological Observations . . . . .	17,200
5. Mineral surveys . . . . .	5,000
6. Surveys for Pisciculture . . . . .	1,000
7. Malaria surveys . . . . .	2,500
8. Electric Load surveys . . . . .	5,000
9. Surveys for Navigation . . . . .	40,000
10. Economic and property surveys . . . . .	20,000
11. Surveys for soil erosion . . . . .	5,000
12. Communications . . . . .	1,50,000
13. Special Tools and Plant . . . . .	2,30,000
	<hr/> 27,34,500
2 per cent. contingencies . . . . .	54,690
	<hr/> Total Works . . . . . 27,89,190

#### II. TOOLS AND PLANT—

Tools and plant for the Divisions . . . . .	2,19,000
2 per cent. contingencies . . . . .	4,380
	<hr/> Total Tools and Plant . . . . . 2,23,380

#### III. ESTABLISHMENT—

Establishment for 4 years including establishment contingencies . . . . .	12,12,464
	<hr/> Grand Total . . . . . 42,25,034

#### Details

#### I. WORKS—

##### Dams and Appurtenant Works—

##### A. Preliminary Expenses—

1. Survey of the reservoir basins by air photography and ground survey and plotting contours at 10 ft.—5 ft. intervals on a scale of 4"=1 mile

	sq. miles.
Tokarwa . . . . .	275
(a) Ukai/dam . . . . .	
(b) Nawtha Dam . . . . .	34
(c) Atawadhna dam . . . . .	18.6
(d) Waghar and Panjhra dam . . . . .	15
	<hr/> Total . . . . . 342.6

342.6 Sq. Miles @ Rs. 375 per Sq. mile . . . . .	Rs. 1,28,000
2. Survey of the dam sites and weir sites by air photography and ground surveys and plotting on a scale of 32"=1 mile.	
	acres.
(a) Ukai/Tokarwa dam site . . . . .	2,000
(b) Kakrapar weir site . . . . .	600
(c) Hatnur weir site . . . . .	600
(d) Nawtha dam site . . . . .	600
(e) Atawadhna dam site . . . . .	600
(f) Panjhra dam site . . . . .	800
(g) Waghar dam site . . . . .	1,800
8,000 acres at Rs. 4 per acre . . . . .	32,000
3. Geological investigations for foundations of the dam sites and weir sites and of the reservoir basins by boring, core-drilling making drifts and tunnelling etc., including testing.	

	Nos.	
(a) Kakrapar Well . . . . .	22	
(b) Ukai/Tokarwa dam . . . . .	160	
(c) Hatnur well . . . . .	20	
(d) Nawtha dam . . . . .	27	
(e) Arawadina dam . . . . .	27	
(f) Waghur dam . . . . .	40	
(g) Panjhra dam . . . . .	100	
	<hr/> 400	
400 nos. each of 50,20,000 Rft @ Rs. 20 per Rft . . . . .		4,00,000
4. Soil analysis and burrow surveys for earthen dams, including testing . . . . .	L. S.	10,000
5. Model Experiments by the Indian Waterways Station Poona . . . . .	L. S.	10,000
K. Buildings—		<hr/> 5,80,000
Temporary buildings . . . . .	L. S.	60,000
II. Main canals and branches—		
(a) Surveys of the commanded areas for alignment of canals.	Acres.	
Canals ex. Kakrapara . . . . .	7,00,000	
Canals ex. Hatnur . . . . .	5,00,000	
Canals ex. Waghur and Panjhra . . . . .	50,000	
	<hr/> 12,50,000	
12,50,000 acres at Rs. 1/2 per acre . . . . .		14,06,300
(b) Miscellaneous surveys . . . . .	L. S.	10,000
(c) Exploration for the foundation of cross drainage works and necessary surveys . . . . .		50,000
(d) Soil surveys 12,50,000 acres at Rs. 1 per 100 acres . . . . .		12,500
		<hr/> 14,78,800
III. Discharge and Silt Observations (Period 4 years)—		
One boatman and four khalsias at each discharge site, cost of ropes discharge rods, floats, gauges, silt samplers and laboratory equipment . . . . .		
7 sites (5 on Tapti and 2 on Waghur and Panjhra) at Rs. 5,000 per site per year . . . . .		1,40,000
IV. Meteorological Observations, rain gauges, temperature, humidity and wind velocity observations—		
Equipment and installation of ten new rain gauges (some of these to be of integrated self recording type) Humidity and wind velocity apparatus at five stations, at an average rate of Rs. 1,000 . . . . .		10,000
Recurring expenditure on part time observations 10 observers at Rs. 15 p.m. for 4 years . . . . .		7,200
		<hr/> 17,200
V. Mineral Surveys . . . . .	L. S.	5,000
VI. Surveys for Pisciculture . . . . .	L. S.	1,000
VII. Malaria survey . . . . .	L. S.	500
VIII. Electrical Load surveys . . . . .	L. S.	5,000
IX. Surveys for navigation . . . . .	L. S.	40,000
X. Economic and property surveys . . . . .	L. S.	20,000
XI. Surveys for soil erosion . . . . .	L. S.	5,000
XII. Communications—		
Constructing 50 miles of temporary roads and maintenance for 4 year at Rs. 3,000 per mile . . . . .		1,50,000
XIII. Special Tools and Plant—		
3 Diamond drills complete with accessories at Rs. 60,000 each . . . . .		1,80,000
Testing apparatus and lab. and workshop equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture content, consolidation, etc. . . . .	L. S.	50,000
		<hr/> 2,30,000
		<hr/> 27,37,500
2 per cent. contingencies . . . . .		54,600
Total Works.		<hr/> 27,89,100

## II. TOOLS AND PLANT—

	Rs.
1. Motor vehicles for survey parties 7 vehicles at Rs. 7,000 each	49,000
Working expenses for 4 years.	70,000
2 Scientific Instruments	60,000
3. Ordinary Tools and Plant	5,000
4. Camp equipage	15,000
5. Office furniture	20,000
	<hr/>
2 per cent. contingencies	2,19,000
	4,380
Total Tools and Plant	<hr/>
	2 23,380

## III. ESTABLISHMENT—

	Expenditure per year
1. <i>Pay of officers—</i>	
Executive Engineer 1 No. at Rs. 875 p.m.	10,500
Asstt. Executive Engineer 2 Nos. at Rs. 600 p.m.	14,400
Asstt. Engineers 2 Nos. at Rs. 560 p.m.	13,120
Geologist 1 No. at Rs. 875 p.m.	10,500
Asstt. Geologist 2 Nos. at Rs. 500 p.m.	12,000
Drill Foreman 1 No. at Rs. 1,000 p.m.	12,000
	<hr/>
	72,840
2. <i>Pay of establishment —</i>	
1 Meteorological Assistant at Rs. 240 p.m.	2,880
1 Accountant at Rs. 200 p.m.	2,400
1 Head Clerk at Rs. 180 p.m.	2,160
3 Senior Clerks at Rs. 150 p.m.	5,400
1 Storekeeper at Rs. 150 p.m.	1,800
1 Senior Draftsman at Rs. 200 p.m.	2,400
7 Junior Clerks at Rs. 93 p.m.	7,812
1 Junior Draftsman at Rs. 143 p.m.	1,716
2 Tracers at Rs. 104 p.m.	2,496
1 Sub Asstt. Surgeon at Rs. 170 p.m.	2,040
1 Compounder at Rs. 50 p.m.	600
16 Overseers at Rs. 240 p.m.	46,080
3 Research Assistants at Rs. 240 p.m.	8,640
1 Laboratory Assistant at Rs. 230 p.m.	2,760
1 Silt Analyst at Rs. 200 p.m.	2,400
1 Asstt. Silt Analyst at Rs. 93 p.m.	1,116
5 Gauge Readers at Rs. 70 p.m.	4,200
5 Senior Observers at Rs. 90 p.m.	5,400
1 Dafadars at Rs. 33 p.m.	396
5 Barkandaz at Rs. 33 p.m.	1,980
Peons at Rs. 33 p.m.	2,772
3 Laboratory khalsis at Rs. 33 p.m.	1,188
5 Chowkidars at Rs. 33 p.m.	1,980
	<hr/>
	1,10,616
3. Dearness allowance for officers	9,720
4. Dearness allowance of establishment	32,940
5. Travelling allowance for officers	20,000
6. Travelling allowance for establishment	13,000
7. Cost of Project Circle office debited to Tapti	17,000
8. Establishment contingencies	10,000
	<hr/>
Establishment per year	3,03,116
	<hr/>
Total establishment for four years	12,12,464

G. N. PANDIT,  
Project Officer, (Narbada and Tapti)

**II. ESTIMATE FOR PRELIMINARY SURVEYS AND INVESTIGATIONS IN CONNECTION WITH PROJECTS FOR MULTIPURPOSE DEVELOPMENT IN THE BASIN OF TAPTI RIVER FOR THE YEAR 1947-48 SUBMITTED TO GOVERNMENT FOR SANCTION.**

	<i>Abstract</i>	Rs.
I. WORKS		61,960
II. TOOL AND PLANT		1,56,684
III. ESTABLISHMENT		41,895

Grant total 2,66,540

**I. WORKS—**

	Rs.
1. Dams and appurtenant works—	
(i) Survey to be carried out by the Survey of India Department . L. S.	2,500
(ii) Survey to be carried out by or under the directions of the C. W. I. N. C. . . . . L. S.	19,000
2. Main canals and Branches —Soil surveys . . . . . L. S.	12,640
Discharge and silt Observations . . . . .	4,570
Geological investigations and mineral surveys . . . . .	1,000
5. Communications . . . . .	10,000
6. Special Tools and Plant (Drill equipment and apparatus for soil laboratory) . . . . . L. S.	11,000
7. Contingencies 2 per cent. . . . .	1,250
<b>Total works</b>	<b>61,960</b>

**II. TOOL AND PLANT—**

6 weapon carriers at Rs. 7,000 each . . . . .	42,000	
2 jeeps with trailers at Rs. 7,000 each . . . . .	14,000	
2 country boats at Rs. 1,000 each . . . . .	2,000	
3 outboard motors at Rs. 1,000 each . . . . .	3,000	
6 chronographs at Rs. 100 each . . . . .	600	
8 levelling instruments at Rs. 800 each . . . . .	6,400	
1 theodolite at Rs. 1,500 . . . . .	1,500	
1 Binocular at Rs. 200 each . . . . .	200	
8 measuring chains at Rs. 15 each . . . . .	120	
30—100 ft. tapes at Rs. 30 each . . . . .	900	
30—50 ft. tapes at Rs. 20 each . . . . .	600	
3 steel tapes at Rs. 100 each . . . . .	300	
5 Drawing boards at Rs. 30 each . . . . .	150	
5 second class drawing instruments boxes at Rs. 200 each . . . . .	1,000	
2 First class drawing instruments boxes at Rs. 300 each . . . . .	600	
Scales with offsets, French curves and miscellaneous scientific instruments and tools and plant . . . . .	800	
8 current meters at Rs. 1,000 each . . . . .	8,000	
6 large boats for discharge observations at Rs. 1,000 each . . . . .	6,000	
6 small boats at Rs. 500 each . . . . .	3,000	
Discharge rods . . . . .	800	
Ropes . . . . .	4,000	
1 set of laboratory apparatus for silt observations at Rs. 1,500 each . . . . .	1,500	
Recurring laboratory equipment . . . . .		200
14 by 14 tents 5 Nos. at Rs. 1,200 each . . . . .	6,000	
10 by 10 tents 15 Nos. at Rs. 800 each . . . . .	12,000	
15 shouldaries at Rs. 600 each . . . . .	9,000	
15 servants, tents at Rs. 600 each . . . . .	9,000	
Camp furniture L. S. . . . .	4,000	
Office furniture for Divisional and Sub Divl. offices . . . . .	9,000	
Office furniture for soil physicist's office and laboratory . . . . .	3,000	
Office furniture for geologist's office . . . . .	2,996	
<b>Total</b>	<b>1,52,436</b>	
(b) Repairs and Carriage—Repairs to Trucks . . . . .		1,000
(c) Contingencies 2 per cent. . . . .	3,049	
<b>Total Tools and Plant</b>	<b>1,55,485</b>	<b>1,200</b>
<b>Grand Total</b>	<b>1,56,685</b>	

**III. ESTABLISHMENT—**

(a) Pay of officers—	
1 Executive Engineer for 3 months at Rs. 900 p.m. . . . .	2,700
2 Assistant Engineers at Rs. 350 p.m. . . . .	2,100
1 Geologist for 3 months at Rs. 600 p.m. . . . .	1,800
1 Soil Physicist for 4 months at Rs. 275 p.m. . . . .	1,100
<b>Total</b>	<b>7,700</b>

*Pay of establishment.—*

5 Overseers for 3 months @ 180- p.m.	2,700
1 Head clerk for 3 months @ 160- p.m.	480
1 Accountant for 3 months @ 200- p.m.	600
1 Sub Assistant Surgeon for 1 month @ 200- p.m.	200
2 Clerks for 3 months @ 80- p.m.	480
4 Sub Divl. clerks for 3 months @ 75- p.m.	900
1 Junior Draftsman for 3 months @ 100- p.m.	300
2 Tracers for 3 months @ 80- p.m.	480
1 Dispenser for 1 month @ 80- p.m.	80
1 Daffadar for 1 month @ 35- p.m.	35
2 Barkandaz for 1 month @ 30- p.m.	60
4 Peons for 3 months @ 30- p.m.	360
2 Peons for 3 months for officers @ 30- p.m.	180
2 Dak runners for 3 months @ 30- p.m.	180
5 Khalasis for 3 months for overseers @30/- p.m.	450
3 Gauge readers for 3 months @ 30- p.m.	270
Geologists' staff L.S.	600
6 Sub overseers for 4 months @ 50- p.m.	1,200
3 Laboratory Assistants for 4 months @ 100- p.m.	1,200
2 Clerks for 4 months @ 40- p.m. each	320
1 Computer for 4 months @ 40- p.m. each	160
1 Tracer for 4 months @ 40- p.m. each	160
3 Laboratory peons for 4 months @ 25- p.m. each	300
2 Peons for 4 months @ 25- p.m.	200
1 Tapali for 4 months @ 25- p.m.	100
4 Auger measurers for 4 months @ 40- p.m. each	640
<b>Total</b>	<b>12, 630</b>

Dearness allowances and Special Pay of Officers L.S.	1,965
Dearness allowance of establishment L.S.	8,000
Travelling allowance of officers	
1 Executive Engineer	800
2 Assistant Engineers	800
1 Geologist	1,800
1 Soil Physicist	1,750
	<b>5,150</b>

*Travelling allowance of establishment :—*

Supervisors	1,200
Other staff (Executive Engineer) ...	1,600
Geologist — Other staff	200
Sub-overseers	600
Auger measures	600
Other Staff	500
	<b>4,700</b>

*(b) Establishment Contingencies.—*

Rent for Divisional and Sub Divisional offices	1,000
Rent for Soil Physicist's office and laboratory	500
Rent for Geologist's office	250
	<b>1,750</b>
<b>Total of establishment</b>	<b>41,895</b>

G. N. PANDIT,  
Project Officer, (Narbadā and Tapti).

### III ESTIMATE FOR THE PRELIMINARY SURVEY AND INVESTIGATIONS WITH THE PROJECTS FOR MULTIPURPOSE DEVELOPMENT IN THE BASIN OF THE TAPTI RIVER FOR THE YEAR 1948-49, SUBMITTED TO GOVERNMENT FOR SANCTION

	Abstract	Rs.
I. WORKS . . . . .		16,76,000
II. TOOLS AND PLANT . . . . .		1,00,000
III. ESTABLISHMENT . . . . .		2,80,000
Grand Total . . . . .		20,56,000
I. WORKS—		
1. Dams and Appurtenant Works — A. Preliminary Expenses.		
Survey to be carried out by the survey of India Deptt . . . . .		2,00,000
Surveys to be carried out by or under directions of C.W.I.N.C. L.S. . . . .		20,000
K. Buildings L.S. . . . .		25,000
2. Main canal and Branches.—		
Misc. surveys as canal alignments, Special reservoir surveys etc. . . . .		25,000
Soil surveys L.S. . . . .		45,000
3. Discharge and Silt Observations L.S. . . . .		50,000
4. Meteorological surveys.—		
(i) Rain gauges— It is proposed to instal 30 new gauges (i) Equipment and installation of gauges 30 new rain gauges including temperature, humidity and wind velocity apparatus at 15 places and some self recording gauges at an average rate of 500/- each . . . . .		15,000
(ii) Observation expenditure per year		
1 Meteorological Assistant at 200/- p.m. . . . .		2,400
1 Senior observer at 120/- p.m. . . . .		1,440
30 Part time observers at Rs. 15- p.m. each . . . . .		5,400
30 Part time retainers at Rs. 12- p.m . . . . .		4,320
		13,560
(b) Seismological surveys L.S. . . . .		28,560
		10,000
		38,560
Say . . . . .		38,000
5. Geological Investigations and mineral surveys etc. L.S. . . . .		10,000
6. Communications L.S. . . . .		25,000
7. Special Tools and Plant (Drill equipment and apparatus for soil laboratory) L.S. . . . .		12,00,000
8. Economic surveys L.S. . . . .		3,000
9. Hydro-Electric Installations.—A. Preliminary expenses		
Electric Load surveys L.S. . . . .		2,000
Contingencies at 2 per cent . . . . .		33,000
Total Works . . . . .		16,76,000
II. TOOLS AND PLANT—		
3 country boats at Rs 1000- each . . . . .		3,000
6 Chronogaphs at Rs 100- each . . . . .		600
4 Levelling instruments at Rs 800- each . . . . .		3,200
2 Theodolites at Rs. 1500- each . . . . .		3,000
2 Binoculars at Rs. 200- each . . . . .		400
1 Camera at Rs 600- . . . . .		600
4 Measuring chains at Rs. 15- each . . . . .		60
10—100 ft. tapes at Rs. 30- each . . . . .		300
10—50 ft. tapes at Rs. 20- each . . . . .		200
2 Steel tapes at Rs. 100- each . . . . .		200
Scales with offsets, french curves and Misc. . . . .		
Scientific instruments, tools and plant . . . . .		200
4 current meter at Rs. 1000- each . . . . .		4,000
6 Large boats at Rs. 1000- each . . . . .		6,000
6 Small boats at Rs. 500- each . . . . .		3,000
Discharge rods . . . . .		200
Recurring laboratory equipment . . . . .		200
Ropes . . . . .		1,500
7 Nos. 14' x 14' tents at Rs. 1200- each . . . . .		8,400
20 Nos. 10' x 10' tents at Rs. 800- each . . . . .		16,000
20 Shouldaries at Rs. 600- each . . . . .		12,000
20 Servants tents at Rs. 600- each . . . . .		12,000
Camp furniture . . . . .		3,000
Office furniture for Divl. and Sub. Divl. offices . . . . .		12,000
Office furniture for soil Physicist office and Lab. . . . .		2,000
Office furniture for geologist office . . . . .		2,000
(b) Repairs and Carriage-Yearly repairs to trucks . . . . .		3,500
2 per cent contingencies . . . . .		2,000
Total Tools and Plant . . . . .		99,580
		Say 1,00,000

## III. ESTABLISHMENT.—

*Pay of Officers.—*

1 Executive Engineer for 12 months @ Rs. 900 p.m.	10,800
4 Assistant Engineers for 12 months @ Rs. 350 p.m.	16,800
1 Geologist for 12 months @ Rs. 600 p.m.	7,200
2 Asstt. Geologists for 12 months @ Rs. 400 p.m.	9,600
1 Soil Physicist at Rs. 275 p.m.	3,300
	<hr/>
	47,700

*Pay of establishment.—*

16 Overseers for 12 months @ Rs. 180 p.m.	34,560
1 Head clerk for 12 months at Rs. 160 p.m.	1,920
1 Accountant for 12 months at Rs. 200 p.m.	2,400
1 Sub Asstt. Surgeon for 12 months at Rs. 200 p.m.	2,400
5 Clerks for 12 months at Rs. 80 p.m.	4,800
8 Sub Divl. clerks for 12 months at Rs. 75 p.m.	7,200
1 Head Draftsman for 12 months @ Rs. 250 p.m.	3,000
1 Junior Draftsman for 12 months @ Rs. 100 p.m.	1,200
2 tracers for 12 months @ Rs. 80 p.m.	1,920
1 Dispenser for 12 months @ Rs. 80 p.m.	960
1 Daffadar for 12 months @ Rs. 35 p.m.	420
5 Barkandaz for 12 months @ Rs. 30 p.m.	1,800
11 Peons for 12 months @ Rs. 30 p.m.	3,960
6 Peons for 12 months for officers @ Rs. 30 p.m.	2,160
5 Chowkidars for 12 months @ Rs. 30 p.m.	1,800
6 Dak runners for 12 months @ Rs. 30 p.m.	2,160
16 Khalasis for overseers for 12 months @ Rs. 30 p.m.	5,760
10 Gauge readers for 12 months @ Rs. 30 p.m.	3,600
Geologists staff L.S.	7,400
6 Sub Overseers for 12 months at Rs. 50 p.m.	3,600
3 Laboratory Asstts for 12 months @ Rs 100 p.m.	3,600
2 Clerks for 12 months @ Rs. 40 p.m.	960
1 Computer for 12 months @ Rs. 40 p.m.	480
1 Tracer for 12 months @ Rs. 40 p.m.	480
3 Laboratory peons for 12 months @ Rs. 25 p.m.	900
2 Peons for 12 months @ Rs. 25 p.m.	600
1 Tapali for 12 months @ Rs. 25 p.m.	300
4 Auger measurers for 12 months @ Rs. 40 p.m.	1,920
	<hr/>

Total . . . . . 1,02,260

Dearness allowance and Special pay of Officers L.S. . . . . 12,235

Dearness allowance of establishment . . . . . 49,000

*Travelling Allowance of officers.—*

Executive Engineers . . . . .	3,200
Assistant Engineers . . . . .	6,200
Geologist . . . . .	7,200
Asstt. Geologists . . . . .	9,000
Soil Physicist . . . . .	5,250
	<hr/>
	30,850

*Travelling allowance of establishment.—*

Supervisors . . . . .	14,800
Other staff XEN'S . . . . .	6,400
Geologist other staff . . . . .	2,300
Soil survey staff.—	
Sub overseers . . . . .	1,900
Auger measurers . . . . .	1,900
Other staff . . . . .	2,155
	<hr/>
	29,455

*Establishment contingencies.—*

Rent for Divl. and Sub Divl. offices . . . . .	4,000
Rent for soil physicist office and laboratory . . . . .	1,500
Rent for geologist office . . . . .	3,000
	<hr/>
	8,500

Total Establishment . . . . . 2,80,000

G. N. PANDIT,  
Project Officer, (Narbada & Tapi) .



**IV ESTIMATE FOR PRELIMINARY SUREVYS AND INVESTIGATIONS IN CONNECTION WITH  
PROJECTS FOR THE MULTI-PURPOSE DEVELOPMENTS OF THE TAPTI BASIN, PREPARED  
IN ACCORDANCE WITH THE INSTRUCTIONS OF THE *ad hoc* COMMITTEE.**

*Abstract.*

**I. WORKS—**

	Rs.
1. Dams and appurtenant Works—	
A. Preliminary Expenses . . . . .	3, 19,525
K. Buildings . . . . .	40,000
2. Main Canals and Branches . . . . .	4,36,750
3. Discharge and Silt observations . . . . .	70,000
4. Meteorological observations . . . . .	13,600
5. Mineral surveys . . . . .	5,000
6. Surveys for Pisciculture . . . . .	1,000
7. Malaria survey . . . . .	2,500
8. Electric Load Surveys . . . . .	4,000
9. Surveys for Navigation . . . . .	40,000
10. Economic and Property surveys . . . . .	15,000
11. Surveys for soil erosion . . . . .	4,000
12. Communications . . . . .	90,000
13. Special Tools and Plant . . . . .	1,70,000
	<hr/> 12,11,375
3 per cent. contingencies . . . . .	24,227
	<hr/> 12,35,602

II. TOOLS AND PLANT . . . . . 1,87,680

III. ESTABLISHMENT . . . . . 5,72,232

Grand Total . . . . . 19,95,514

Or Say . . . . . 19,95,500

*DETAILS*

**I. WORKS—**

**1. Dams and appurtenant works—**

**A. Preliminary Expenses—**

	Rs.
1. Survey of the Reservoir Basin by Air photography and ground survey and plotting contours at 10 ft.—5 ft. intervals on a scale of 4=1 mile 275 sq. miles of Ukai/Tokarwa Dam at Rs. 375 per sq. mile . . . . .	1,03,125
2. Survey of dam and weir site by air photography and ground survey and plotting on a scale of 32"=1 mile—	

	Acres.
Ukai/Tokarwa dam site . . . . .	3,000
Kakarpar weir site . . . . .	600
	<hr/> 3,600

3,600 acres at Rs. 4 per acre . . . . . 14,400

**3. Geological investigations for foundations of dam site and weir site and of the reservoir basin by boring, core drilling, making drifts and tunnelling etc. including testing—**

	Nos.	
Kakarpar weir . . . . .	22	
Ukai/Tokarwa dam . . . . .	180	
182 Nos. each of 50 R ft.—9,100 R ft. at Rs. 20 per R ft. . . . .		1,82,000
4. Soil Analysis and burrow surveys including testing . . . . .		L. S. 10,000
5. Model experiments by the Indian Waterways Station Poona . . . . .		L. S. 10,000
		<hr/> 3,19,525

K. Buildings—Temporary Buildings . . . . . L. S. 40,000

**II. Main Canals and Branches—**

(a) Surveys of the commanded area for canal alignment 7,00,000 acres at 0-9-0 per acre . . . . .	3,93,750
(b) Miscellaneous surveys . . . . .	L. S. 6,000
(c) Exploration for the foundations of cross drainage works and necessary surveys . . . . .	L. S. 30,000
(d) Soil surveys 7,00,000 acres at Re. 1 per 100 acres . . . . .	7,000
	<hr/> 4,36,750

**III. Discharge and Silt observations—**

**Period 2 years**

One boatman and four khalasis at each discharge site, cost of ropes, discharge rods, floats, gauges, silt samplers and laboratory equipment 7 sites at Rs. 5,000 per site per year . . . . .	70,000
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**IV. Meteorological observations—**

**Rain gauges, temperature, humidity and wind velocity observations—**

Equipment and installation of ten new rain gauges (some of these to be of the integrated self-recording type) and humidity and wind velocity apparatus at 5 stations, at an average rate of Rs. 1,000 . . . . .	10,000
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Recurring expenditure on part time observations 10 observers at Rs. 15 p.m. for 2 years . . . . . 3,600

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13,600

V. Mineral surveys . . . . .	L. S.	Rs. 5,000
VI. Surveys for Pisciculture . . . . .	L. S.	1,000
VII. Malaria survey . . . . .	L. S.	2,500
VIII. Electric load survey . . . . .	L. S.	4,000
IX. Survey for Navigation . . . . .	L. S.	40,000
X. Economic and Property surveys . . . . .	L. S.	15,000
XI. Surveys for soil erosion . . . . .	L. S.	4,000
XII. Communications—		
Constructing 30 miles of temporary roads and their maintenance for 2 years at Rs. 3,000 per mile . . . . .		90,000
XIII. Special Tools and Plant—		
1. 2 Diamond Drills complete with accessories at Rs. 60,000 each. . . . .		1,20,000
2. Testing apparatus and laboratory and workshop equipment for compressive strength of rocks and testing soils for shear strength, optimum moisture contents, consolidation etc. . . . .	L. S.	50,000
		1,70,000
		12,11,375
2 per cent. contingencies . . . . .		24,227
		12,35,602
II. TOOLS AND PLANT—		
1. Motor vehicles for survey parties 7 vehicles at Rs. 7,000 each . . . . .		49,000
Working expenses for 2 years . . . . .		35,000
2. Scientific Instruments . . . . .		60,000
3. Ordinary tools and plant . . . . .		5,000
4. Camp equipage . . . . .		15,000
5. Office furniture . . . . .		20,000
		1,84,000
2 per cent. contingencies . . . . .		3,680
		1,87,680
Total tools and plant . . . . .		
III. ESTABLISHMENT—		
	Expenditure per year.	
1. Pay of officers—		
1. Executive Engineer at Rs. 875 p.m. . . . .		10,500
2. Asstt. Executive Engineers at Rs. 600 p.m. . . . .		14,400
2. Asstt. Engineers at Rs. 560 p.m. . . . .		13,440
1. Geologist at Rs. 875 p.m. . . . .		10,500
2. Asstt. Geologists at Rs. 500 p.m. . . . .		12,000
1. Drill Foreman at Rs. 1,000 . . . . .		12,000
		72,840
2. Pay of Establishment—		
1. Meteorological Asstt. at Rs. 240 p.m. . . . .		2,880
1. Accountant at Rs. 200 p.m. . . . .		2,400
1. Head Clerk at Rs. 180 p.m. . . . .		2,160
3. Senior Clerks at Rs. 150 p.m. . . . .		5,400
1. Storekeeper at Rs. 150 p.m. . . . .		1,800
1. Senior Draftsman at Rs. 200 p.m. . . . .		2,400
7. Junior Clerks at Rs. 93 p.m. . . . .		7,812
1. Junior Draftsmen at Rs. 143 p.m. . . . .		1,716
2. Tracers at Rs. 104 p.m. . . . .		2,496
1. Sub Asstt. Surgeon at Rs. 170 p.m. . . . .		2,040
1. Compounder at Rs. 50 p.m. . . . .		600
16. Overseers at Rs. 240 p.m. . . . .		46,080
3. Research Asstts. at Rs. 240 p.m. . . . .		8,640
1. Laboratory Asstt. at Rs. 230 . . . . .		2,760
1. Silt Analyst at Rs. 200 . . . . .		2,400
1. Asstt. Silt Analyst at Rs. 93 . . . . .		1,116
5. Gauge Readers at Rs. 70 . . . . .		4,200
5. Senior observers at Rs. 90 . . . . .		5,400
1. Dafadars at Rs. 33 . . . . .		396
5. Barkandaz at Rs. 33 . . . . .		1,980
7. Peons at Rs. 33 . . . . .		2,772
3. Laboratory Khalasis at Rs. 33 . . . . .		1,188
5. Chowkidars at Rs. 33 . . . . .		1,980
		1,10,616

	Rs.
3. Dearness allowance for officers . . . . .	19,720
4. Dearness allowance for establishment . . . . .	32,940
5. Travelling allowance for officers . . . . .	20,000
6. Travelling allowance for establishment . . . . .	13,000
7. Cost of Project Circle office debitable to Tapti . . . . .	17,000
8. Establishment contingencies . . . . .	10,000
Establishment per year . . . . .	<u>2,86,116</u>
Total Establishment for 2 years . . . . .	<u>5,72,232</u>

G N. Pandit

*Project Officer, (Narbada & Tapti)*

APPENDIX VI.  
Sabarmati Project  
Report

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(I) *The Sabarmati River.*

The Sabarmati river drains a catchment area of 1,723 square miles before entering the Dharoi Gorge. The catchment area above Ahmedabad is about 5,000 square miles. The maximum discharge of the river at Dharoi is about 3,00,000 cusecs, while at Ahmedabad it may be taken to be about 5,00,000 cusecs.

Two important tributaries, the Hathmati (Hill Catchment about 237 square miles) and the Khari (Hill catchment about 100 square miles) meet the Sabarmati between Dharoi and Ahmedabad. Below Ahmedabad, the main stream of the Meshwa System consisting of Meshwa (Hill Catchment about 316 square miles), Migham (Hill Catchment about 157 square miles) and Vatrak (Hill Catchment about 450 square miles) joins the river.

The river is a source of considerable danger to the industrial town of Ahmedabad and villages lower down. Monsoon floods in the past have caused devastation, destroyed crops, carried away cattle, changed course of delta channels and filled up harbours with silt.

(II) *Works and proposals in the past.*

In the past some very small dams and anicuts for storage and irrigation have been constructed on the tributaries of the river. No large works have been undertaken although proposals to harness the main channel of the Sabarmati river have been under contemplation as far back as the second half of the nineteenth century. A scheme was drawn up in 1904 by Bombay Engineers to construct a dam at Dharoi and three pick up weirs at different places down the river up to Ahmedabad. The scheme was, however, dropped as it was not considered at the time sufficiently remunerative. Nothing tangible was done till 1935, when the Baroda Engineers started investigations and by 1942 produced a scheme, the details of which are available in two Volumes. As the project could not proceed without the agreement of the several States having riparian rights and other interests in the waters of Sabarmati, the Baroda State referred it to the Bombay Government, who in turn sought the opinion of the Government of India. In addition, the Baroda Government wanted their project to be 'vetted' by the Central Waterways, Irrigation and Navigation Commission, and for that purpose a party of Engineers of the CWINC, headed by the Member for Irrigation, visited the area by air and land routes, and discussed the scheme with various interests informally and in conferences. All interests showed keenness to participate in a unified multipurpose development of the Sabarmati basin and not in piecemeal schemes and also wanted that the preparation of such a project be undertaken by the CWINC and that a special Division be opened under it for this purpose.

(III) *Proposals.*

To implement the decisions arrived at in the conferences referred to in paragraph II, available data has been studied and proposals are drawn up for opening a Division to complete investigations for drawing up a scheme for unified multipurpose development of the entire Sabarmati basin.

A statement showing the rough details of the dam sites and possible irrigation areas is enclosed. The main work lies on the Sabarmati river itself, as there are possibilities for a dam at Dharoi, where the main stream debouches in the plains. The storage capacity of the reservoir formed by a dam of about 150 feet height at this site may be as much as 30,000 m.c. ft, which is expected in normal years to equal almost all the run off from the catchment up to this point. The regulated discharge will be of the order of 500 cusecs yielding about 3,000 to 4,000 K.W. of firm power, ensuring about 100 cusecs of constant flow for Ahmedabad water supply and making possible irrigation to the extent of about 1,00,000 acres with or without the help of pick up weirs between Dharoi and Ahmedabad. Detailed investigations are necessary to find the exact location of the sites for pick up weirs, the alignments for canals and location of the areas to be irrigated.

From a study of the form line sheets, possible sites for a dam on the Hathmati, a dam on Ghuvai, a pick up weir on the Hathmati for the above two dams, a dam and pick up weir on Meshwa, a dam on Vatrak and a dam on Majham (the main tributaries of the Sabarmati system) have been located very approximately and marked on the index map. The discharge available due to storage at these dams is likely to irrigate another 1,00,000 acres making a total of 2,00,000 acres irrigation over the entire basin

Taking an intensity of 40%, the culturable commanded area should be about 5,00,000 acres. Possible location of the areas making up this figure are shown on the enclosed index map.

*Estimate.*

An estimate is enclosed. Worked out in great detail, it provides for manning a Division with three Sub-Divisions for two years to complete the necessary investigations and to draw up a complete project for the unified multipurpose development of the entire Sabarmati basin.

The estimate amounts to Rs. 15,10,000. Surveys of the reservoir and irrigation areas costing about Rs. 5,86,000 are proposed to be carried out through the Survey of India. All other investigations like the Surveys for dam sites, canal alignment, soil surveys, discharge and silt observations and property surveys are proposed to be carried out independently by the CWINC. Geological surveys including core drilling are proposed to be carried out with the help of resident geologists and under the general advice of the Geological Survey of India. Meteorological Surveys including fixing of new rain-gauges and observatories for recording temperatures, humidity—wind velocity etc. will be planned and carried out by the CWINC. under the guidance of the Meteorological Department.

Necessary provision has been made in the estimate for temporary buildings to accommodate the staff, for communications, for electric load surveys and for laboratory apparatus etc. Necessary provision has also been made for the purchase of office equipment, scientific and ordinary tools and plant, and motor vehicles for transport in the difficult area.

M. D. MITHAL,  
*Director, Irrigation and Waterways.*  
 C. W. I. N. C.

STATEMENT SHOWING PROPOSED DAM SITES AND POSSIBLE IRRIGATION AREA ON SABARMATI  
AND ITS TRIBUTARIES

Name of river or tributary	Site and Location	Dam or pickup weir	Catchment area in sq miles	Possible average annual runoff in million cub ft	Possible annual irrigation in acres	Area to be surveyed in acres for irrigation	Remarks
Sabarmati	Dharoi 72° 51' E, 24° N.	Dam	1,723	15,000			
	Valasna 72° 47' E. 23° 50' W.	Pickup weir			60,000	150,000	
	Waghpur 72° 47' E, 23° 28' N.	Do.			40,000	100,000	
	Ahmedabad. 72° 36' E., 23° 2' N.	Do.					100 cusecs will be reserved for Ahmedabad water supply.
Meshwa	Near Lachhai 73° 10' E., 23° 30' N.	Dam	316	2,800	28,000	70,000	
Meshwa	Near Warwara 73° 5' E, 23° 30' N.	Pickup weir					
Hathmati	Near Fatepur 73° 10' E, 23° 40' N.	Dam	237	2,000	20,000	50,000	
Ghuva	Near Khandial 73° 5' E, 23° 40' N.	Dam	192	1,600	1,6000	40,000	
Hathmati	Near Himmat Nagar. 72° 58' E, 23° 36' N.	Pickup weir					
Vatrak	Near Bhanupura. 73° 22' E, 23° 20' N.	Dam	450	3,900	39,000	97,000	
Majham	Near Munsiwara. 73° 22' E., 23° 17' N.	Dam	157	1,300	13,000	34,000	
		Total	3,075	26,600	216,000	541,000 acres say 850 sq. miles.	

N B—Above the Dharoi dam site, there appear to be some sites for dams as indicated on the plan. These will need to be verified for the sake of negotiations amongst the various interests. The ultimate aim is, however, to concentrate on the Dharoi dam Site.

OVERALL ESTIMATE FOR PRELIMINARY SURVEYS AND INVESTIGATIONS FOR  
POSSIBLE MULTIPURPOSE DEVELOPMENT OF SABARMATI BASIN

*Abstract*

Serial No.	Item	Estimated amount
		Rs.
1.	Survey through the Survey of India Staff under the direction of the C. W. I. N. C. .	5,86,500
2.	Other river and land surveys to be carried out by the C. W. I. N. C. Staff . .	48,500
3.	Soil Surveys . . . . .	17,000
4.	Temporary Buildings . . . . .	10,000
5.	Discharge and Silt Observations . . . . .	69,310
6.	Meteorological surveys . . . . .	2,000
7.	Geological investigations and mineral surveys . . . . .	1,87,960
8.	Communications . . . . .	15,000
9.	Special T. & P. for laboratory apparatus for Soil Survey . . . . .	11,000
10.	Electric load and property surveys . . . . .	15,000
11.	Working of motor vehicles . . . . .	30,000
12.	Establishment . . . . .	2,84,880
13.	Tools and plant . . . . .	1,63,083
14.	Contingencies and Sundries . . . . .	69,767
	Grand Total .	15,10,000

(Sd) M. D. MITHAL,  
*Director Irrigation and Waterways*

## Details

Serial No.	Item	Estimated cost	Total
		Rs.	Rs.
1.	Survey through the Survey of India staff.		
	(a) Survey of reservoir areas scale 4" = 1 mile 100 sq. miles @ Rs. 320/- per sq. mile	32,000	..
	(b) Contoured survey of Irrigation area scale 4" = 1 mile. 850 sq. miles @ Rs. 650/- per sq. mile.	5,52,500	
	(c) Rapid 2" scale map of Dharoi Dam site	2,000	5,86,500
2.	Other river and land surveys to be carried out by C.W.I.N.C. staff.		
	(a) Survey of dam site areas (scale 1/1000) contour interval 5' to 10'. 10 sq. miles @ Rs. 2,600 per sq. mile.	26,000	
	(b) Longitudinal section of the river and its tributaries with cross sections (500 miles @ Rs. 25 per mile).	12,500	
	(c) Mapping shoals, sand bars, deep Channels and installing gauges.	5,000	
	(d) Miscellaneous surveys such as canal alignment, special reservoir surveys etc.	5,000	48,500
3.	Soil surveys.		
	Work Charged establishment for one year.		
	4 Auger Mukadams @ Rs. 55 p.m. for one year = 2,640.		
	16 Khallasies @ Rs. 45 p.m. for one year = 8,640.		
	T. A. for work charged establishment . = 720.		
	= 12,000	12,000	
	Testing Water and soil samples, for one year	5,000	17,000
4.	Temporary Buildings . . . . .	10,000	10,000
5.	Discharge and silt observations . . . . .		
	(a) There will be four discharge sites on Sabarmati and 6 discharge sites on its tributaries.		
	Non recurring expenditure per site on Sabarmati		
	Current meter $\frac{1}{2}$ per site = 500		
	Boat large . . . . . = 800		
	Discharge rods . . . . . = 100		
	Ropes . . . . . = 300		
	Sounding rods . . . . . = 100		
	1,800		
	For 4 sites non-recurring expenditure . = 7,200		
	Recurring expenditure (for 2 years) per site on Sabarmati.		
	$\frac{1}{2}$ observer @ Rs. 150/-p.m. including dearness allowance and special pay for $1\frac{1}{2}$ years . . . = 1,800		
	One boatman @ Rs. 60 p. m. for $1\frac{1}{2}$ years . . . = 1,080		
	4 khallasies @ Rs. 55 p. m. for $1\frac{1}{2}$ years . . . = 3,960		
	6,840		
	Recurring expenditure for 4 sites = $4 \times 6840$ = 27,360.		
	Non recurring expenditure per site on a tributary of Sabarmati—		
	$\frac{1}{2}$ current meter. . . . . = 250		
	Boat small . . . . . = 400		
	Discharge rods and sounding rods . . . = 100		
	Ropes . . . . . = 100		
	850		
	Non recurring expenditure for 6 sites = $6 \times 850$ = 5,100.		
	Recurring expenditure (for 2 years) per site on a tributary of Sabarmati.		
	$\frac{1}{2}$ observer @ Rs. 150 p.m. including dearness allowance and special pay for 2 years . . . = 1,800		



S. No.	Item.	Estimated cost	Total
	One boatman @ Rs. 55 p. m. for 1 year . . . =	660	
	2 khallasies also suitable as boatmen @ Rs. 30 p. m. for 1 year . . . =	1,200	
		3,660	
	Recurring expenditure for 6 sites on tributaries of Sabarmati . . . . . = $6 \times 3,660 =$	21,960	61,620
	(b) <i>Silt observations</i> —		
	Equipment . . . . . =	4,000	
	Work charged establishment for $1\frac{1}{2}$ years.		
	Laboratory Assistant @ Rs. 150 p. m. for $1\frac{1}{2}$ years . =	2,700	
	1 Khallasi @ Rs. 55 p. m. for $1\frac{1}{2}$ years . . . =	990	
		7,690	69,310
6.	Meteorological Surveys—		
	Rain gauges, temperatures, humidity & wind velocity observations.	2,000	2,000
7.	Geological investigations and mineral Surveys—		
	(a) Equipment (non recurring)		
	2 diamond drills with equipment @ Rs. 30,000 each . . . . . =	60,000	
	2 diamonds and spares for the above @ Rs. 20,000 each . . . . . =	40,000	
	1 Calyx drill with equipment . . . . . =	20,000	
	spares for the above . . . . . =	10,000	
	2 large boats for drills @ 1,000 each . . . =	2,000	
	2 compressors @ Rs. 5,000 each . . . . . =	10,000	
	(b) Running expenses for one year	1,42,000	1,42,000
	One Drill foreman @ Rs. 1,500 p. m. for one year =	18,000	
	One Resident Asstt. Geologist @ Rs. 350 p. m. for one year . . . . . =	4,200	
	2 Operators @ Rs. 120 p. m. . . . . =	2,880	
	4 helpers @ Rs. 60 p. m. . . . . =	2,880	
	Dearness allowance & T. A. of staff . . . =	10,000	
	Running expenses for engines for drills etc.— =	8,000	
		45,960	187,960
8.	Communications—		
	Constructing and maintaining temporary roads to various dam sites and gauging stations.	15,000	15,000
9.	Special Tools and Plant for laboratory apparatus for soil surveys	11,000	11,000
10.	Electric load and property Surveys . . . . .	15,000	15,000
11.	Working of motor vehicles (for 2 years @ Rs. 15,000 per year).	30,000	30,000
12.	Establishment—		
	(a) Pay of Officers—		
	1 Executive Engineer @ Rs. 760 p. m. for 2 years =	18,240	
	3 Asstt. Engineers @ Rs. 350 p. m. for 2 years =	25,200	
	1 Soil Physicist @ Rs. 275 p. m. for one year . =	3,300	46,740
	(b) Pay of Establishment—		
	12 Supervisors @ Rs. 140 p. m. for 2 years . . =	40,320	
	1 Accountant @ Rs. 200 p. m. for 2 years . . =	4,800	
	One Head Clerk @ Rs. 160 p. m. for 2 years . =	3,840	
	1 Sub-Assistant Surgeon @ Rs. 200 p.m. for 2 years =	4,800	
	5 Clerks @ Rs. 80 p. m. for 2 years . . . =	9,600	
	3 Sub Divisional Clerks @ Rs. 75 p. m. for two years . . . . . =	5,400	
	1 Accounts Clerk @ Rs. 100 p. m. for two years . =	2,400	
	1 Head Draftsman @ Rs. 300 p. m. for 2 years =	7,200	
	1 Junior Draftsman @ Rs. 100 p.m. for 2 years =	2,400	
	2 Tracers @ Rs. 60 p. m. for 2 years . . . =	2,880	
	1 Computer @ Rs. 60 p. m. for 2 years . . . =	1,440	
	1 Ferro Printer @ Rs. 60 p. m. for 2 years . =	1,440	
	1 Dispenser @ Rs. 80 p. m. for 2 years . . =	1,920	
	1 Storekeeper @ Rs. 80 p. m. for 2 years . . =	1,920	

S. No.	Item	Estimated cost	Total
4	Daffadars @ Rs. 35 p. m. for 2 years . . . =	3,360	
5	Barkandazes @ Rs. 30 p. m. for 2 years . . . =	3,600	
2	Suboverseers @ Rs. 60 p. m. for 2 years . . . =	2,880	
9	Peons (3 for Division, 2 for each sub-division) for 2 years @ Rs. 30 p. m. . . . =	6,480	
2	Peons (1 for Asstt. Geologist, 1 for soil Physicist) for 1 year @ Rs. 30 p. m. . . . =	720	
4	Peons for Officers (one for Ex. Engr. and 1 each for S.D.O.'s) for 2 years @ Rs. 30 p. m. =	2,880	
6	Chowkidars @ Rs. 30 p. m. for 2 years . . . =	4,320	
1	Daftri @ Rs. 35 p. m. for 2 years . . . =	840	
6	Dak Runners @ Rs. 30 p. m. for 2 years . . . =	4,320	
12	Khallasies @ Rs. 30 p. m. for 2 years . . . =	8,640	
11	Gauge readers @ Rs. 30 p. m. for 2 years . . . =	7,920	
1	Laboratory Attendant @ Rs. 40 p.m. for 1½ years . . . . . =	720	
2	Clerks for Asstt. Geologist and Soil Physicist for one year @ Rs. 40 p.m. . . . . =	960	
3	Clerks special pay for handling cash for 2 years @ Rs. 20 p. m. . . . . =	1,440	
	Geologist staff for one year . . . . . =	2,000	
		1,41,440	1,41,440
(c)	Dearness allowance for officers . . . . .		8,000
(d)	Dearness allowance for establishment . . . . .		24,000
(e)	Travelling allowance for officers—		
	Executive Engineer (2 years) . . . . . =	7,200	
	Asstt. Engineers (2 years) . . . . . =	8,600	
	Asstt. Geologist (1 year) . . . . . =	1,800	
	Soil Physicist (1 year) . . . . . =	1,800	
		19,400	19,400
(f)	Travelling allowance for establishment—		
	Overseers (2 years) . . . . .	21,600	
	Other Staff (2 years) . . . . .	10,000	
	Geologist Staff (1 year) . . . . .	1,400	
		33,000	33,000
(g)	Establishment Contingencies—		
	Rent for divisional and Sub Divisional offices for 2 years . . . . .	7,000	
	Rent for Soil Physicist office for one year . . . . .	1,500	
	Rent for Asstt. Geologist's office for 1 year . . . . .	1,500	
	Rent for Laboratory for 1½ years . . . . .	2,300	
		12,300	12,300
			2,84,880
13	TOOLS AND PLANT—		
(a)	Scientific instruments and drawing materials—		
	5 No. Levelling instruments with stand @ Rs. 700 each . . . . .	3,500	
	1 No. Theodolite with stand @ Rs. 1,000 each . . . . .	1,000	
	5 No. Prismatic compasses with stand @ Rs. 160 each . . . . .	800	
	5 No. Planetables with stand @ Rs. 100 each . . . . .	500	
	14 No. Levelling staves @ Rs. 40 each . . . . .	560	
	4 No. Scale boxes complete with scales and offsets @ Rs. 15 each . . . . .	60	
	2 No. Planimeters @ Rs. 200 each . . . . .	400	
	20 No. Tapes metallic 100 feet @ Rs. 30 each . . . . .	600	
	20 No. Tapes metallic 50 ft. @ Rs. 20/- each . . . . .	400	
	2 No. Instrument drawing boxes 1st size @ Rs. 300 each . . . . .	600	
	4 No. Instrument drawing boxes 2nd size @ Rs. 200 each . . . . .	800	
	6 No. Instrument drawing boxes 3rd size @ Rs. 100 each . . . . .	600	
	2 No. parallel rulers @ Rs. 40 each . . . . .	80	
	Set squares of sizes L. S. . . . .	100	
	7 No. Drawing boards @ Rs. 30 each . . . . .	210	
	7 No. T. Squares @ Rs. 10 each . . . . .	70	
	18 No. Measuring Chains 100' long with arrows @ Rs. 40 each . . . . .	720	
	6 No. Measuring chains 66' long with arrows @ Rs. 30 each . . . . .	180	

S. No.	Item	Estimated cost	Total
2 No.	French curve boxes @ Rs. 30 each	60	
2 No.	Straight edges brass @ Rs. 30 each	60	
5 No.	Rulers 2 feet fourfold @ Rs. 8 each	40	
1	Slide rule @ Rs. 200 each	200	
5	Colour boxes complete @ Rs. 50 each	250	
12 No.	China slops for colours @ Rs. 3 each	36	
2 No.	Steel tapes @ Rs. 100 each	200	
1 No.	Apparatus for printing plans	300	
2 No.	proportional compasses @ Rs. 30 each	60	
2 No.	Glasses magnifying @ Rs. 40 each	80	
18 No.	Poles surveying @ Rs. 15 each	270	
24 No.	Ranging rods @ Rs. 5 each	120	
18 No.	Umbrellas field @ Rs. 50 each	900	
12 No.	Chronographs @ Rs. 90 each	1,080	
1	Camera @ Rs. 400 each	400	
4	Binoculars @ Rs. 200 each	800	
		16,036	16,036
(b) <i>Plants and Machinery—</i>			
1 G. M. C. Truck	@ Rs. 10,000 each	10,000	
4	Weapon carriers @ Rs. 7,000 each	28,000	
6	Jeeps with trailers @ Rs. 6,000 each	36,000	
		74,000	74,000
(c) <i>Tools—</i>			
6 No.	Augers with extension pieces @ Rs. 100 each	600	
6 No.	axes carpenters @ Rs. 15 each	90	
12 No.	hammers of sizes @ Rs. 5 each	60	
24 No.	G. I. Buckets @ Rs. 4 each	96	
24 No.	axes country @ Rs. 8 each	192	
12 No.	hammers stone breaking @ Rs. 2 each	24	
	Pegs iron and nails L. S.	100	
24 No.	Pick axes @ Rs. 5 each	120	
12 No.	Plumbs brass @ Rs. 3 each	36	
6 No.	Saws Hand @ Rs. 8 each	48	
1 No.	stencil plate figures @ Rs. 25 each	25	
1 No.	stencil plate letters @ Rs. 30 each	30	
24 Nos.	Fire buckets @ Rs. 4 each	96	
4 No.	Iron safes @ Rs. 400 each	1,600	
		3,117	3,117
(d) <i>Camp equipment—</i>			
12 No.	chairs folding with arms @ Rs. 16 each	192	
24 No.	tables camp folding @ Rs. 35 each	840	
12 No.	Cotton durries @ Rs. 80 each	960	
16 No.	Yakduns (record boxes) @ Rs. 40 each	640	
1 No.	Swiss cottage double fly tent 14' x 14' @ Rs. 1,200	1,200	
6 No.	Swiss cottage double fly tents 12' x 12' @ Rs. 1,000	6,000	
20 No.	double fly tents 10' x 10' @ Rs. 700 each	14,000	
20 No.	tents double fly 8' x 8' @ Rs. 500 each	10,000	
12 No.	servants tents @ Rs. 600 each	7,200	
12 No.	shouldaries @ Rs. 600 each	7,200	
6 No.	necessary tents @ Rs. 150 each	900	
7	Bath Boards wooden @ Rs. 5 each	35	
7	Wash hand basins @ Rs. 4 each	28	
7	Jugs @ Rs. 4 each	28	
6	Cots folding @ Rs. 50 each	300	
36	Country charpoys @ Rs. 9 each	324	
4	Lamps petromax @ Rs. 50 each	200	
24	Hurricane lanterns @ Rs. 5 each	120	
7	Buckets G. I. @ Rs. 5 each	35	
4	Boxes for petromax lanterns @ Rs. 5 each	20	
		50,222	50,222

S. No.	Item	Estimated cost	Total
<i>(e) Office furniture—</i>			
	7 No. tables for officers @ Rs. 125 each . . . . .	875	
	20 No. tables with two drawers, handles and locks @ Rs. 60 each . . . . .	1,200	
	4 No. tables camp folding for clerks @ Rs. 35 each . . . . .	140	
	48 No. Office cane chairs @ Rs. 15 each . . . . .	720	
	6 No. easy cane chairs @ Rs. 30 each . . . . .	180	
	16 No. Cupboards with shelves & Locks @ Rs. 100 . . . . .	1,600	
	26 No. record stands with shelves @ Rs 35 each . . . . .	910	
	5 Nos. Yakdans or boxes @ Rs. 40 each . . . . .	200	
	7 No. Benches for peons @ Rs. 25 each. . . . .	175	
	12 No. Teapoyes @ Rs. 15 each . . . . .	180	
	20 No. Hurricane lanterns @ Rs. 5 each . . . . .	100	
	4 No. cupboards with six drawers 8" high each, 3' wide 4' long and 5' high for plans @ Rs. 125 each. . . . .	500	
	12 No. Buckets G. I. @ Rs. 5 each . . . . .	60	
	14 No. baskets waste paper @ Rs. 3 each . . . . .	42	
	16 No. call bells @ Rs. 4 each . . . . .	64	
	12 Nos. stools wooden @ Rs. 6 each . . . . .	72	
	1 No. Typewriter portable @ Rs. 300 . . . . .	300	
	5 No. typewriters remington rand @ Rs. 450 each . . . . .	2,250	
	5 Nos. scales with weights 1 to 20 tolas @ Rs. 30 each . . . . .	150	
	12 Nos. cash and stamps boxes steel @ Rs. 20 each . . . . .	240	
	5 pigeon holes for despatch clerks @ Rs. 50 each . . . . .	250	
	Miscellaneous petty items such as pen-knives, scissors, locks, inkstands, liveries of peons, etc. . . . .	1,500	
		11,708	11,708
<i>(f) R. &amp; C. of T. &amp; P.—</i> . . . . .			
		8,000	8,000
<b>ABSTRACT—</b>			
	Scientific instruments and Drawing materials . . . . .	16,036	
	Plants and Machinery . . . . .	74,000	
	Tools . . . . .	3,117	
	Camp equipage . . . . .	50,222	
	Office furniture . . . . .	11,708	
	R. & C. of T. & P. . . . .	8,000	
	<b>Total</b> . . . . .	<b>1,63,083</b>	<b>1,63,083</b>
14	Contingencies and sundries.	69,767	69,767

## Yearly distribution of the amount of the overall estimate for Sabarmati Investigations.

Serial No.	Item	Estimated amount	Probable 1948-49 6 months	expenditure 1949-50	during 1950-51
		Rs.	Rs.	Rs.	Rs.
1	Surveys through the Survey of India staff under the direction of C. W. I. N. C.	5,86,500	42,000	3,22,500	2,22,000
2	Other river and land surveys to be carried out by C. W. I. N. C. staff.	48,500	6,000	28,500	14,00
3	Soil Surveys . . . . .	17,000	..	17,000	..
4	Temporary Buildings . . . . .	10,000	5,000	5,000	..
5	Discharge and Silt Observations . . . . .	69,310	17,000	34,310	18,000
6	Meteorological Surveys . . . . .	2,000	1,000	600	400
7	Geological investigations and Mineral Surveys. . . . .	1,87,960	25,000	1,62,960	..
8	Communications . . . . .	15,000	10,000	5,000	..
9	Special T. & P. for Laboratory Apparatus for soil Survey. . . . .	11,000	11,000	..	..
10	Electric load and property surveys . . . . .	15,000	..	15,000	..
11	Working of motor vehicles . . . . .	30,000	7,500	15,000	7,500
12	Establishment . . . . .	2,84,880	70,000	1,44,880	70,000
13	T. & P. . . . .	1,63,083	40,000	1,13,083	10,000.
14	Contingencies and Sundries . . . . .	69,767	15,500	36,167	18,100
	Total .	15,10,000	2,50,000	9,00,000	3,60,000

(Sd) M. D. MITHAL,  
Director, Irrigation and Waterways.

ESTIMATE FOR PRELIMINARY SURVEYS AND INVESTIGATIONS  
IN CONNECTION WITH PROJECTS FOR MULTIPURPOSE DE-  
VELOPMENT OF THE SABARMATI BASIN PREPARED IN ACCOR-  
DANCE WITH THE INSTRUCTIONS OF THE *AD-HOC* COMMITTEE.

*Abstract*

I. WORKS

1. Dams and Appurtenant works

A preliminary Expenses . . . . . 75,120

K Buildings . . . . . 10,000

2. Main Canal and Branches . . . . . 1,44,900

3. Discharge and Silt Observations . . . . . 33,400

4. Meteorological Observations . . . . . 2,000

5. Mineral Surveys . . . . . 5,000

6. Surveys for Pisciculture . . . . . 1,000

7. Malaria Surveys . . . . . 2,000

8. Electrical Load Surveys . . . . . 10,000

9. Economic and Property Surveys . . . . . 5,000

10. Communications . . . . . 10,000

11. Special Tools and Plant . . . . . 71,000

3,69,420

2% contingencies . . . . . 7,388

Total Works . . . . . 3,76,808

II. Tools and Plant.

Tools and Plant . . . . . 1,41,000

2% contingencies . . . . . 2,820

1,43,820

III. Establishment . . . . . 2,66,210

GRAND TOTAL . . . . . 7,86,838

Say . . . . . 7,87,000

(Sd.) M. D. MITHAL,

*Director Irrigation and Waterways*

*Details***I. WORKS.—****Dams and Appurtenant Works.****A Preliminary Expenses.**

1. Survey of the reservoir basins by Air photography and ground survey and plotting contours at 10 ft. —5ft. intervals on a scale of 4" —1 Mile. 40 square miles @ 375/- per sq. Mile. . . . .	15,000
2. Survey of the dam sites and weir sites by air photography and ground surveys and plotting on scale of 32"=1 mile. 1280 acres @ 4-0 per acre . . . . .	5,120
3. Rapid 2" map of Dharoi dam site . . . . .	2,000
4. Geological Investigation for foundations of the dam sites and weir sites and of the reservoir basins by boring, core drilling making drifts and tunnelling, etc. including testing. 46 holes each of 50—2300 R. Ft. @20/- per R.Ft. . . . .	46,000
5. Soil analysis and burrows surveys for earthen dams including testing . . . . .	5,000
6. Model experiments by the Indian Waterways Station Poona . . . . .	2,000

75,120

**K. Buildings.**

Temporary Buildings. . . . .	10,000
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**II. Main Canals and Branches.**

(a) Surveys of the commanded area for alignment of canals 1,20,000 acres @ 1-2-0 per acre . . . . .	1,35,000
(b) Miscellaneous Surveys . . . . .	5,000
(c) Longitudinal Section of the river and its tributaries with cross sections 100 miles @ 25/- per mile. . . . .	2,500
(d) Soil Surveys, L.S. . . . .	2,400

1,44,900

**III. Discharge and Silt observations (Period October 1948 to May 1950=20 months). One boatman and four khallasies at each discharge site, cost of ropes, discharge rods, floats, gauges, silt samplers and laboratory equipment.**

4 sites at Rs. 5000/- per site per year for 20 months . . . . .	33,400
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IV. Meteorological observations, raingauges temperature, humidity and wind velocity observations . . . . .	2,000
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V. Mineral Surveys. . . . .	5,000
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VI. Surveys for Pisciculture . . . . .	1,000
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VII. Malaria Surveys. . . . .	2,000
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VIII. Electrical Load Surveys . . . . .	10,000
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IX. Economic and Property surveys . . . . .	5,000
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X. Communications . . . . .	10,000
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XI. Special Tools and Plant. 1 Diamond drill complete with accessories @ Rs. 60,000 each. . . . .	60,000
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Testing apparatus and lab equipment for compressive strength of rocks, optimum moisture content, consolidation, etc. . . . .	11,000
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71,000

3,69,420

7,388

2% contingencies . . . . .	7,388
<b>Total works . . . . .</b>	<b>3,76,808</b>

**II. TOOLS AND PLANT**

1. Motor vehicles for survey parties. 7 vehicles @ 7000/- each . . . . .	49,000
2. Working expenses for 15 months . . . . .	22,000
3. Scientific instruments and drawing materials . . . . .	30,000
4. Ordinary Tools and Plant . . . . .	5,000
5. Camp equipage . . . . .	15,000
6. Office Furniture . . . . .	15,000
7. R & C of T & P . . . . .	5,000

1,41,000

2% contingencies . . . . .	2,820
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<b>Total tools and Plant . . . . .</b>	<b>1,43,820</b>
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**III. ESTABLISHMENT****1. Pay of Officers—**

Executive Engineer 1 No. @ 875/- p.m. for 15 months . . . . .	13,125
Assistant Engineers 3 No. @ 560/-p.m. for 15 months. . . . .	25,200
Asstt. Geologist 1 No. @ 500/- p.m. for 6 months. . . . .	3,000
Drill Foreman 1 No. @ 1000/- p.m. for 6 months. . . . .	6,000

47,325

2. *Pay of Establishment.*

Accountant 1 No. @200/- p.m. for 15 months . . . . .	3,000
Head Clerk 1 No. @180/- p.m. for 15 months . . . . .	2,700
Senior Clerk 3 Nos. @ 150/- p.m. for 15 months . . . . .	6,750
Storekeeper 1 No. @ 150/- p.m. for 15 months . . . . .	2,250
Senior Draftsman 1 No. @ 200/- p.m. for 15 months . . . . .	3,000
Junior Clerks 7 Nos. @ 93/- p.m. for 15 months . . . . .	9,765
Junior Draftsman 1 No. @ 143/- p.m. for 15 months . . . . .	2,145
Tracers 2 Nos. @ 104/-p.m. for 15 months . . . . .	3,120
Sub-Assistant Surgeon @ 170/- p.m. for 15 months . . . . .	2,550
Compounder 1 No. @ 50/- p.m. for 15 months . . . . .	750
Overseers 12 Nos. @ 240/- p.m. for 15 months. . . . .	43,200
Research Assistant 1 No. @ 240/- p.m. for 15 months . . . . .	3,600
Laboratory Asstt. 1 No. @230/- p.m. for 15 months . . . . .	3,450
Silt Analyst 1 No. @ 200/- p.m. for 15 months . . . . .	3,000
Asstt. Silt Analyst 1 No. @ 93/- p.m. for 15 months . . . . .	1,395
Gauge readers 5 Nos. @ 70/- p.m. for 15 months . . . . .	5,250
Senior Observers 4 Nos. @ 90/- p.m. for 15 months. . . . .	5,400
Daffadars 4 Nos. @ 33/- p.m. for 15th months . . . . .	1,980
Barkandazes 5 Nos. @ 33/- p.m. for 15 months . . . . .	2,475
Peons 13 No. @ 33/- p.m. for 15 months . . . . .	6,435
Khallasies for overseers 12 Nos. @ 33/- p.m. for 15 months . . . . .	5,940
Laboratory Khallasies 3 Nos. @ 33/- p.m. for 15 months . . . . .	1,485
Chowkidars 5 Nos. @ 33/- p.m. for 15 months . . . . .	2,475
Dak Runners 5 Nos. @ 33/- p.m. for 15 months . . . . .	2,475
Ferroprinter 1 No. @ 60/- p.m. for 15 months . . . . .	900
Daftri 1 No. @ 33/- p.m. for 15 months . . . . .	495
Special pay for 3 Clerks for handling cash for 15 months @ 20/- p.m. . . . .	900
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	1,26,885
3. Dearness Allowance for Officers for 15 months . . . . .	7,000
4. Dearness Allowance for establishment for 15 months . . . . .	38,000
5. Travelling allowance for officers for 15 months . . . . .	20,000
6. Travelling allowance for establishment for 15 months . . . . .	15,000
7. Establishments contingencies (for 15 months). . . . .	12,000
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Total Establishment . . . . .	2,66,210

## TOOLS AND PLANT.

1. *Plant and Machinery.*

Motor vehicles 7 No. @ 7000/- each . . . . .	49,000
Working expenses for 15 months . . . . .	22,000
	<hr/>
	71,000

2. *Scientific instrument and Drawing materials*

Levels 12 No. @ 850/- each . . . . .	10,200
Folding footrules 12 No. @ 7/- each . . . . .	84
Plotting scales 12 No. @ 30/- each . . . . .	360
Set Squares transparent 8" (45° and 60°), 12 pairs @ 15/- per pair . . . . .	180
1st quality Drawing Instrument box 1 No. @ 160/- each . . . . .	160
2nd quality Drawing instrument boxes 12 Nos. @ 62/8/- each . . . . .	750
French curve set 1 No. @ 30/- each . . . . .	30
Parallel rulers 5 Nos. @ 60/- each . . . . .	300
Survey Umbrellas 4 Nos. @ 62/8 each . . . . .	250
Theodolite 1 No. @ 2800/- each . . . . .	2,800
Levelling Staves 16 pairs @ 150/- per pair . . . . .	2,400
One hundred feet chains 16 Nos. @ 40/- each . . . . .	640
100' Metallic Tapes 20 No. @ 30/- each . . . . .	600
50' Metallic Tapes 20 No. @ 24/- each . . . . .	480
Plane-tables with stand 5 No. @ 100/- each . . . . .	500
Prismatic compasses 4½" dia. 4 No. @ 310 each . . . . .	1,240
Ranging Rods 72 No. @ 5/- each . . . . .	360
Large size stanley planimeter 1 No. @ 400/- each . . . . .	400
Small size planimeter 1 No. @ 250/- each . . . . .	250
Stop watches 5 No. @ 100/- each . . . . .	500
Steel tapes 2 No. @ 70/- each . . . . .	140
Drawing boards with T. Square 7 No. @ 50/- each . . . . .	350
10' Slide rule 1 No. @ 50/- each . . . . .	50
Clinometers 2 No. @ 150/- each . . . . .	300



6" celluloid semicircular protractors 4 No. @ 5/- each . . . . .	20
Abney levels in case with stand 2 Nos. @ 360/- each . . . . .	720
36" straight edge 1 No. @ 72/- each . . . . .	72
Proportional compasses 2 No. @ 30/- each . . . . .	60
Current meters 4 No. @ 1,000/- each . . . . .	4,000
Magnifying glasses 5 No. @ 16/- each . . . . .	80
Blue print apparatus 1 No. @ 600/- each . . . . .	600
Camera 1 No. @ 300/- each . . . . .	300
Prismatic binoculars 2 No. @ 250/- each . . . . .	500
66' measuring chains 5 No. @ 30/- each . . . . .	150
Colour boxes complete 3 No. @ 50/- each . . . . .	150
China Slops for colours 12 No. @ 2/- each . . . . .	24
Total . . . . .	30,000

### 3. Ordinary Tools and Plant.

Augers 20 No. @ 100/- each . . . . .	2,000
Carpenters axes 6 No. @ 20/- each . . . . .	120
Country axes 30 No. @ 8/- each . . . . .	240
G.I. Buckets 24 No. @ 4/- each . . . . .	96
Hammers of size 24 No. @ 6/- each . . . . .	144
Stone breaking hammers 12 No. @ 3/- each . . . . .	36
Copper ghadas for water 10 No. @ 15/- each . . . . .	150
Iron pegs and nails L. S. . . . .	100
Pick axes 48 No. @ 6/- each . . . . .	288
Brass Plumbs 24 No. @ 3/- each . . . . .	72
Hand Saws 12 No. @ 8/- each . . . . .	96
Stencil plate figures 1 No. @ 29/- each . . . . .	29
Stencil plate letters 1 No. @ 30/- each . . . . .	30
Fire buckets 48 No. @ 8/- each . . . . .	384
Nail extractors 6 No. @ 10/8/- each . . . . .	63
Phahorahs 48 No. 10/- each . . . . .	480
Crowbars 24 No. @ 25/- each . . . . .	600
Sundries . . . . .	72
Total . . . . .	5,000

### 4. Camp Equipage.

Chairs folding 13 No. @ 12 each . . . . .	192
Tables camp folding 16 No. @ 30/- each . . . . .	480
Swiss cottage double fly tent 1 No. 12' x 12' @ 1000/- each . . . . .	1,000
Double fly tents 10 No. 10' x 10' @ 700 each . . . . .	7,000
Shouldaries 12 No. @ 500/- each . . . . .	6,000
Necessary tent 1 No. @ 100/- each . . . . .	100
Country charpoys 24 No. @ 8 each . . . . .	192
Sundries . . . . .	36
Total . . . . .	15,000

5. *Office Furniture.*—

Officer's Writing tables 1 No. @ 170/- each . . . . .	170
Writing tables 5' × 3' × 2½' with oil cloth 6 No. @ 125/- each . . . . .	750
Writing table with 2 drawers 25 No. @ 100/- each . . . . .	2,500
Office chairs 50 No. @ 20/- each . . . . .	1,000
Easy chairs 6 No. @ 35/- each . . . . .	210
Cupboards 6' × 4' × 1½' 16 No. @ 125/- each . . . . .	2,000
Record stands 4' × 3½' × 1½' 16 No. @ 40/- each . . . . .	640
Steel trunks 16 No. @ 25/- each . . . . .	400
Cupboards 4' × 3' × 1½' 16 No. @ 60/- each . . . . .	960
Benches with backs (5' × 15" × 18") 7 No. @ 30/- each . . . . .	210
Steel stamp boxes 6 No. @ 10/- each . . . . .	60
Cotton floor carpets 5 No. @ 100/- each . . . . .	500
Teapots 16 Nos. @ 20/- each . . . . .	320
Cupboards 4' × 3' × 5' with 6 drawers each 8" high for plans 6 No. @ 150/- each. . . . .	900
Waste paper baskets 14 No. @ 2/- each . . . . .	28
Call Bells 12 No. @ 4/- each . . . . .	48
Peon belts 13 No. @ 5/- each . . . . .	65
High Chairs for tracers 2 No. @ 20/- each . . . . .	40
Chamber pot 1 No. @ 5/- each . . . . .	5
Locks 36 No. @ 3/- each . . . . .	108
Brass pad locks 8 Nos. @ 15/- each . . . . .	120
Pigeon holes for despatch clerks 5 No. @ 25/- each . . . . .	125
Scales and weights 5 No. @ 20/- each . . . . .	100
Steel cash boxes 5 No. @ 25/- each . . . . .	125
Portable type writer 1 No. @ 300/- each . . . . .	300
Standard type writer 1 No. @ 450/- each . . . . .	450
Hurricane Lanterns 24 No. @ 5/- each . . . . .	120
Table Lamps 10 No. @ 25/- each . . . . .	250
Cycles 2 No. @ 225/- each . . . . .	450
Safes 4 No. @ 400/- each . . . . .	1,600
Stools wooden 12 No @ 6/- each . . . . .	72
Sundries . . . . .	374
<b>Total</b> . . . . .	<b>15,000</b>

6. R. & C. of T & P. . . . . **5,000**

## Yearly distribution of the amount of the foregoing estimate

	Year 1948-49	Year 1949-50
<b>I. WORKS</b>		
<i>(i) Preliminary Expenses.</i>		
1. Survey of reservoir basin . . . . .	7,500	7,500
2. Survey of Dam Site . . . . .	5,120	..
3. Rapid 2" map of Dharoi dam site . . . . .	2,000	..
4. Geological investigations . . . . .	..	46,000
5. Soil analysis etc. . . . .	5,000	..
6. Model Experiments . . . . .	..	2,000
<i>(ii) Buildings.</i>		
Temporary Buildings . . . . .	10,000	..
<i>(iii) Main Canals and Branches.</i>		
1. Survey of the commanded area . . . . .	67,500	67,500
2. Miscellaneous Surveys . . . . .	..	5,000
3. Longitudinal Section of the river . . . . .	2,500	..
4. Soil Surveys . . . . .	2,400	..
<i>(iv) Discharge and silt observation . . . . .</i>	20,000	13,400
<i>(v) Meteorological Observations . . . . .</i>	2,000	
<i>(vi) Mineral Surveys . . . . .</i>	5,000	..
<i>(vii) Surveys for Pisciculture . . . . .</i>	..	1,000
<i>(viii) Malaria Surveys . . . . .</i>	2,000	
<i>(ix) Electric Load Surveys . . . . .</i>	..	10,000
<i>(x) Economic and Property Surveys . . . . .</i>	2,500	2,500
<i>(xi) Communications . . . . .</i>	10,000	..
<i>(xii) Special Tools and plants . . . . .</i>	..	60,000
<i>(xiii) Testing Apparatus and lab equipment . . . . .</i>	11,000	..
Contingencies . . . . .	2,555	4,995
	<hr/> 1,57,075	<hr/> 2,19,895
<b>II. TOOLS AND PLANTS</b>		
Tools and Plants . . . . .	1,43,820	..
<b>III. ESTABLISHMENT</b>		
	<hr/> 1,33,105	<hr/> 1,33,105
Grand Total . . . . .	<hr/> 4,34,000	<hr/> 3,53,000

(Sd.) M. D. MITHAL.  
Director, Irrigation and Waterways

## APPENDIX VII

### C. P. & BASTAR PROJECTS.

Central Provinces & Berar together with Bastar State which has recently merged into this province are one of the richest provinces of India in minerals. There are vast deposits of coal, bauxite, iron, copper, manganese, limestone etc. etc. The quality of coal found, however, is rather inferior and on that account practically no industrial use of the mineral wealth of the tract has so far been attempted. Surveys for the purpose of utilising the water resources of the area were undertaken about thirty years ago but the results were surprisingly disappointing. In the main it was brought out that in spite of the copious rainfall over the entire area the resources could not be utilised to produce cheap power or cater for much irrigation! At the request of the C. P. Government a fresh survey was undertaken by the CWINC and it was discovered that potential for power exceeded one million K. Ws. and water could also be made available for perennial irrigation of nearly a million acres of cultivated and cultivable land.

In Bastar State at the request of the State Ministry a similar survey was carried out. This State has about the richest iron ore deposits concentrated in two small areas one on either side of the river Indravati. The percentage of iron in the ores is believed to be from 68 to 70. Potential of power on the Indravati river was found to be nearly 300,000 K. Ws. continuous. The plateau of Jugdulpore was similarly discovered to be in a very undeveloped state, only a small portion being utilised for cultivation while actually cultivation could be extended over a much larger level and fertile area.

The possibilities of development were discussed with the Government of C. P. & Berar and their technical officers and at a conference held in April, 1947 it was decided to select 8 projects besides those on the Narbada and Tapti for investigations with a view to prepare the detailed development estimates. C. P. Government also desired that the work of investigations should be done by the CWINC. The sites selected for investigations are given in the accompanying list in which other details of the projects are also shown. Similarly the projects for Bastar State have also to be investigated by CWINC. Details of the projects in that area are also shown in the list. The estimate amounting to Rs. 71,17,140/- has been prepared to cover the cost of necessary work involved in the surveys and investigations. It is proposed to set up a Circle with three divisions and requisite number of subdivisions, subordinates and ministerial staff to man the work of investigations. As in other programmes of investigations, survey works of dam sites, reservoir areas, areas to be commanded for irrigation will be completed through the agency of the Survey of India Department. Hydrological surveys and Geological surveys will be done in close co-operation with the Indian Meteorological Department and Geological Survey of India respectively. Provision has also been made for surveys for malaria control, fish culture, navigation, soil-conservation etc. Provision for the acquisition of necessary plant for geological and hydrological and other surveys has been adequately made. The work is estimated to take four years to complete. The principal feature of the 12 projects, 8 in C.P. and Berar and 4 in Bastar state are shown in accompanying statement.

Index map showing dam sites etc. is enclosed.

K. M. BHATIA,  
Project Officer,  
C. W. I. N. C.

## ROUGH DATA FOR DAM SITES.

Sl. No.	Name of tributary	Name of Nearest village	Longitude & latitude of left bank at dam site	Names of States or provinces in which dam and water spread fall.	Maps in which the dam & water spread falls	Approx. distance from head in miles	Catchment area in sq. miles	R. L. of top of proposed dam above M.S.L.	Approx. height of dam above bed of river in feet	Length of water spread at dam in thousand feet	Capacity in million A. Ft.	Submerged area in acres	Minimum power (in feet itself) K.W.	Minimum connection with other projects) K. W.	Irrigation Potential (acres)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Pench River	North of Alkata	79°16' E 21°43' N	C. P.	55 O/5,1	122 miles on Kanhan river	1416.8	1750	125	11.12	662	15870	6300	6300	1,00,000
2	Wainganga river	North of Khapa	80° E 22°23' N	C. P.	55N/15& 64B/3	100	1377.28	1450	75	8.745	36	15488	1800	1800	50,000
3	Penganga river	At Amti	77°22' E 19°53' N	C. P. & a little of Hydera- bad	56E/5,1 55H/4 56D/16	252	1596.8	1600	120	2.97	1.432	35200	13400	13400	3,00,000
4	Wardha river	East of Morai	78°5' E 21°23' N	C. P.	55, K/3,7	70	1726.72	1150	116	6.765	0.533	24000	4370	4370	75,000
5	Pairi river	North of Nirai & Mohra	81°59' 30" E 20°41' N	C. P.	64H/14 & L/2 64M/14	37	1196.8	1140	110	4.455	1.22	48000	6360	6360	1,00,000
6	Jonk River	East of Uprani	82°33' E 21°35' 30" N	C. P.	64 K/10 64 K/10 11.12	93	1227.2	880	112	7.746	1.22	50,000	5000	5000	1,00,000
7	Hasado	North of Lotlota	82°42' 30" E 22°28' 30" N	C. P.	64 J/11,10 64 J/11	104	3090	1050	120	1.5	.893	16448	6520	6520	3,00,000
8	Mahanadi	At Satia- ra	81°28' E 20°33' 45" N	C. P. & Eastern States	64 M/6 64 N/6, 7, 10 11	62	1133	1207	77	5.280	1.22	28000	5000	5000	1,50,000
9 } 10 } 11 }	Indravati river tributary of Godavari	Chitrakote	81°43' E 19°12' N	Eastern States			5000						27000	27000	very little
		Barsur	81°24' E 19°12' N	Eastern States			7347						32500	65000	very little
		Bhopalpat- nam	80°18' E 18°47' N	C. P. & Eastern States	65B/5 65 A/4,8 B/1, 5, 9	102	16312	450	160	5.280	.8.75	154000	87680	128000	very little
12	Sabari	Gumma	81°52' E 18°35' N	C. P. & Eastern States			2744	800	100	1.980	2.4	64000	14400	22000	6,90,000

## C. P. &amp; BASTAR PROJECTS

Overall estimate for the preliminary surveys and investigations on 12 projects in the Central Provinces and Bastar State. (4 in upper Mahanadi basin, 4 in middle Godavari basin, and 4 in Bastar State).

## ABSTRACT

## I. WORKS

## (I) Dams and Appurtenant Works.

	Rs.
(A) Preliminary Expenses . . . . .	6,80,000
(K) Buildings . . . . .	1,50,000
(II) Main canals and branches . . . . .	10,60,000
(III) Discharge observations . . . . .	3,10,000
(IV) Silt Observations . . . . .	1,37,200
(V) Property Surveys . . . . .	28,800
(VI) Meteorological Surveys . . . . .	1,08,720
(VII) Geological Surveys . . . . .	19,61,040
(VIII) Communications . . . . .	1,50,000
	<hr/> 45,85,760

2% Contingencies

92,000

TOTAL WORKS .

46,77,760

## II. TOOLS AND PLANTS

4,46,000

## III. ESTABLISHMENT

19,93,380

TOTAL .

71,17,140

## Distribution—

1/3 debitable to Upper Mahanadi basin . . . . .	23,72,380
1/3 debitable to middle Godavari basin . . . . .	23,72,380
1/3 debitable to Bastar State projects . . . . .	23,72,380

## Allotments required.

1st year	2nd year	3rd year	4th year
16,52,000	20,65,000	17,00,000	17,00,000

## DETAILS

## I. WORKS

## (I) Dam and Appurtenant Works.

## (A) Preliminary expenses.

## (a) Surveys to be carried out by Survey of India.

## Reservoir Surveys.—

Pairi . . . . .	75 sq. miles
Jonk . . . . .	78 do.
Hasado . . . . .	26 do.
Mahanadi . . . . .	44 do.
Bhopalpatnam . . . . .	241 do.
Sabri . . . . .	100 do.
Chitrakot & Barasur . . . . .	300 do.
Pench . . . . .	25 do.
Wain ganga . . . . .	25 do.
Pain ganga . . . . .	55 do.
Wardha . . . . .	38 do.
	<hr/> 1,007 do.

1,007 sq. miles @ 375/- per sq. mile. . . . . 3,80,000

## (b) Surveys to be carried out by C. W. I. N. O.

Longitudinal Sections and other miscellaneous surveys like canal alignment surveys, special reservoir surveys, pisciculture etc.

12 sites @ 25,000/- per site . . . . . 3,00,000

6,80,000

## (K) Buildings —

Temporary buildings—Lump Sum . . . . . 1,50,000

## (II) Main canals and branches.

Survey of irrigation area.

18,75,000 acres @ /9/- per acre . . . . . 10,60,000

(III) *Discharge observations* (No. of sites—12) (one at each project site)

<i>Expenditure per site</i>	(non-recurring)
1 current meter @ 1,200/- . . . . .	1,200
1 large boat @ 1,000/- . . . . .	1,000
1 small boat @ 500/- . . . . .	500
1 set velocity rods @ 200/- . . . . .	200
1 set sounding rods @ 100/- . . . . .	100
Ropes etc. . . . .	600
Chronometers . . . . .	200
Rack & Pinion arrangement . . . . .	200
Anchors . . . . .	1,000
<b>(b) Recurring.</b>	<b>5,000</b>
1 gauge reader @ 75/- for 4 years . . . . .	3,600
1 Boatman @ 60/- p.m. for 4 years. . . . .	2,880
6 Khalasies @ 50/- for 4 years . . . . .	14,400
	<b>20,880</b>
Total for one site . . . . .	<b>25,880</b>
Total for 12 sites . . . . .	<b>3,10,000</b>

(IV) *Silt observations*

(i) Equipment non-recurring @ 1000/- per site . . . . .	12,000
(ii) 12 silt observers @ 100/- for 4 years . . . . .	57,600
(iii) 16 khalasies for 4 years @ 50/- p.m. . . . .	57,600
(iv) Miscellaneous on carriage and transport . . . . .	10,000
	<b>1,37,200</b>

(V) *Property Surveys.*

2 surveyors @ 100/- p.m. for 3 years . . . . .	7,200
12 khalasies @ 50/- p.m. for 3 years . . . . .	21,600
	<b>28,800</b>

(VI) *Meteorological Surveys.*

(a) <i>Equipment non-recurring.</i>	
60 new rain gauges @ 500/- each. . . . .	30,000
(b) <i>Recurring.</i>	
2 Meteorological Assistants @ 200/- for 4 years . . . . .	19,200
2 Senior observers @ 120/- for 4 years . . . . .	11,520
60 part-time observers @ 16/- for 4 years . . . . .	48,000
Total Meteorological Surveys . . . . .	<b>1,08,720</b>

(VII) *Geological Surveys.*

(a) <i>Equipment non-recurring.</i>	
8 Diamond Drills @ 75,000/- each . . . . .	6,00,000
Diamonds and other spares @ 40,000/- per set . . . . .	3,20,000
2 calyx drills 5"-6" complete with equipment and spares. . . . .	50,000
8 special boats for drills @ 2000/- each . . . . .	16,000
Testing apparatus . . . . .	1,00,000
	<b>10,86,000</b>

(b) *Recurring expenditure.*

(3 years operations are considered enough).

1 Geologist @ 800/- p.m. for 3 years . . . . .	28,800
2 Assistant Geologist @ 400/- for 3 years . . . . .	28,800
1 Drill foreman @ 1000/- for 3 years . . . . .	36,000
8 Operators (1 per drill) @ 150/- for 3 years . . . . .	43,200
48 helpers (6 per drill) @ 80/- for 3 years . . . . .	1,38,240
Fuel and other expenditure @ 20,000/- p.m. for 30 months . . . . .	6,00,000
Total for Geological surveys . . . . .	<b>8,75,000</b>
	<b>19,61,040</b>

(VIII) *Communications.*

Lump Sum . . . . .	1,50,000
Total of Works . . . . .	<b>45,85,760</b>
2% Contingencies . . . . .	92,000
GRAND TOTAL WORKS . . . . .	<b>46,77,760</b>

## II. TOOLS AND PLANTS—

(a) *Camp equipment.*

12 tents 14' × 14' @ 1,200/- each . . . . .	14,400
30 tents 10' × 10' @ 800/- each . . . . .	14,000
30 shouldaries @ 600/- each . . . . .	18,000
30 servants tents @ 500/- each . . . . .	15,000
Camp furniture . . . . .	7,200
	<hr/>
	78,600

II. (b) *Other tools and plants.*(i) *Non-recurring*

15 3/4 ton weapon carrier trucks @ 7000/- each . . . . .	1,05,000
6 jeeps with trailers @ 7,000/- each . . . . .	42,000
12 outboard motors @ 1,000/- each . . . . .	12,000
48 levelling instruments @ 1000/- each . . . . .	48,000
48 measuring chains @ 50/- each . . . . .	2,400
48-100 ft. tapes @ 30/- each . . . . .	1,440
48-50 ft. tapes @ 20/- each . . . . .	960
8 Theodolites @ 2000/- each . . . . .	16,000
15 binoculars @ 300/- each . . . . .	4,500
20 drawing boards @ 30/- each . . . . .	600
20 plane tables @ 150/- each . . . . .	3,000
12 Prismatic compass @ 150/- each . . . . .	1,800
4 planimeters @ 500/- each . . . . .	2,000
36 drawing instruments boxes 2nd class @ 200/- each . . . . .	7,200
Scales with offsets, French curves etc. . . . .	1,000
	<hr/>
	2,46,940

(ii) *Recurring expenditure*

Repairs and carriage of scientific instruments for 4 years . . . . .	50,000
Running expenses for trucks and jeeps for 4 years . . . . .	1,50,000
	<hr/>
	2,00,000

Total (a) & (b) Tools and Plants . . . . . 4,46,000

## III. ESTABLISHMENT

## (Provision is for 4 years)

1 Superintending Engineer @ 1850/- p.m. . . . .	88,800
3 Executive Engineers @ 800/- p.m. each . . . . .	1,15,500
6 Assistant Executive Engineers @ 600/- p.m. each . . . . .	1,72,800
6 Assistant Engineers @ 500/- p.m. each . . . . .	1,44,000
1 Superintendent @ 300/- p.m. . . . .	14,400
3 Head Clerks @ 200/- p.m. each . . . . .	28,800
3 Accountants @ 200/- p.m. each . . . . .	28,800
1 Stenographer @ 200/- p.m. . . . .	9,600
18 Upper Division clerks including S. D. Cs. @ 100/- p.m. each . . . . .	86,500
32 Lower Division clerks @ 75/- p.m. each . . . . .	1,15,000
3 Steno-typists @ 100/- p.m. each . . . . .	14,400
1 Head Draftsman @ 300/- p.m. . . . .	14,400
3 Senior Draftsmen @ 160/- p.m. each . . . . .	23,040
8 Draftsmen @ 100/- p.m. each . . . . .	38,400
8 Tracers @ 75/- p.m. each . . . . .	28,800
48 Overseers @ 150/- p.m. each . . . . .	3,45,000
3 Sub-Assistant Surgeons @ 150/- p.m. each . . . . .	21,600
6 Research Assistants @ 180/- p.m. each . . . . .	51,900
6 Laboratory Assistants @ 125/- p.m. each . . . . .	36,000
3 Compounders @ 75/- p.m. each . . . . .	10,800
3 Ward boys @ 50/- p.m. each . . . . .	7,200
1 Jemadar @ 40/- p.m. . . . .	1,920
28 peons @ 30/- p.m. each . . . . .	40,500
50 Barkandaz @ 30/- p.m. each . . . . .	72,400
12 Daffadars @ 30/- p.m. each . . . . .	17,300
1 Daftri @ 40/- p.m. . . . .	1,920

TOTAL . 11,93,380

Dearness allowance and increments @ 25 % . . . . . 3,00,000

Travelling allowance . . . . . 3,00,000

Establishment contingencies including office furniture; typewriters etc. . . . . 2,00,000

Total Establishments . 19,93,380

(Sd.) K. M. BHATIA,

Project Officer, C.W.I.N.C.

The 3rd May 1948.



*Estimates for preliminary surveys and investigations in connection with projects for multipurpose development in C. P. and Bastar State prepared in accordance with the suggestions of the Ad-Hoc Committee.*

(ABSTRACT)

I. WORKS—

(I) *Dams and Appurtenant Works —*

(A) Preliminary expenses . . . . .	5,24,000
(K) Buildings . . . . .	1,00,000
(II) Main canals and branches . . . . .	7,59,375
(III) Discharge observations . . . . .	1,65,280
(IV) Silt observations . . . . .	70,600
(V) Property Surveys . . . . .	28,800
(VI) Meteorological surveys . . . . .	84,040
(VII) Geological Surveys . . . . .	16,59,360
(VIII) Communications . . . . .	1,00,000
	<hr/> 35,01,455
2 % contingencies . . . . .	70,029
TOTAL WORKS . . . . .	<hr/> 35,71,484

II. TOOLS AND PLANTS . . . . . 4,27,380

III. ESTABLISHMENT . . . . . 14,10,375

TOTAL . . . . . 54,09,239

*Allocation.*

1/2 of above is debitable to 4 C. P. Projects on Pairi, Jonk, Hasado and Mahanadi rivers . . . . .	Rs. 27,04,620
1/2 of above debitable to 4 projects in Bastar State on Sabari and Indravati (3 projects) rivers . . . . .	Rs. 27,04,620

ALLOTMENT REQUIRED.

1st year.	2nd year.	3rd year.
16 lacs	20·9 lacs	18 lacs

DETAILS

I. WORKS—

(I) *Dam and appurtenant Works —*

(A) *Preliminary expenses.*

(a) Surveys to be carried out by the Survey of India.

Reservoir surveys.

Pairi . . . . .	75 sq. miles.
Jonk . . . . .	78 do.
Hasado . . . . .	26 do.
Mahanadi . . . . .	44 do.
Bhopalapatnam . . . . .	241 do.
Sabari . . . . .	100 do.
Chitrakot & Barasur . . . . .	300 do. (Approx.)
	<hr/> 864 do.

864 sq. miles @ 375/- per sq. mile . . . . . 3,24,000

(b) *Surveys to be carried out by C. W. I. N. O.*

Longitudinal Sections and other miscellaneous surveys like canal alignment surveys, special reservoir surveys, pisciculture etc.

8 sites @ 25,000/- per site . . . . . 2,00,000

(K) *Buildings—*

Temporary buildings Lump Sum . . . . . 1,00,000

(II) *Main Canals and Branches.—*

Survey of irrigation area.

13,50,000 acres @ -/9/- per acre . . . . . 7,59,375

(III) *Discharge observations*

Number of sites—8 (one at each dam site)

*Expenditure per site.*(a) *Equipment non-recurring—*

	Rs.
1 current meter @ 1200/- . . . . .	1,200
1 large boat @ 1000/- . . . . .	1,000
1 small boat @ 500/- . . . . .	500
1 set velocity rods @ 200/- . . . . .	200
1 set sounding rods @ 100/- . . . . .	100
Ropes etc. . . . .	600
Chronometers . . . . .	200
Rack and pinion arrangements . . . . .	200
Anchors . . . . .	1,000
	<hr/> 5,000

(b) *Recurring.*

1 gauge reader @ 75/- for 3 years . . . . .	2,700
1 Boatman @ 60/- for 3 years . . . . .	2,160
6 Khalasis @ 50/- for 3 years . . . . .	10,800
	<hr/> 15,660
Total for one site . . . . .	20,660
For 8 sites . . . . .	1,65,280

(IV) *Silt observations—*

(i) Equipment non-recurring @ 1000/- per site . . . . .	8,000
(ii) 8 silt observers @ 100/- for 3 years . . . . .	28,800
(iii) 16 khalasis @ 50/- for 3 years . . . . .	28,800
(iv) Miscellaneous on Carriage & Transport . . . . .	5,000
	<hr/> 70,600

(V) *Property Surveys—*

2 surveyors @ 100/- p.m. for 3 years . . . . .	7,200
12 Khalasis @ 50/- p.m. for 3 years . . . . .	21,600
	<hr/> 28,800

(VI) *Meteorological Surveys—*(a) *Equipment non-recurring—*

50 new rain gauges @ 500/- each. . . . .	25,000
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(b) *Recurring—*

2 Meteorological Assistants @ 200/- for 3 years . . . . .	14,400
2 Senior Observers @ 120/- for 3 years . . . . .	8,640
50 Part-time observers @ 20/- for 3 years . . . . .	36,000
	<hr/> 84,040

(VII) *Geological Surveys—*(a) *Equipment non-recurring—*

8 Diamond Drills @ 75,000 each . . . . .	6,00,000
Diamonds and other spares @ 40,000 per set . . . . .	3,20,000
2 Calyx drill 5"-6" complete with equipment and spares . . . . .	50,000
8 special boats for drills @ 2000/- each . . . . .	16,000
Testing apparatus for rocks and rock material . . . . .	1,00,000
	<hr/> 10,86,000

(b) *Recurring expenditure—*

1 Geologist @ 800/- for 2 years . . . . .	19,200
2 Assistants Geologists @ 400/- for 2 years . . . . .	19,200
1 Drill Foreman @ 1000/- for 2 years . . . . .	24,000
8 Operators (1 per drill) @ 150/- for 2 years. . . . .	28,800
48 helpers (6 per drill) @ 80/- for 2 years . . . . .	92,160
Fuel and other expenditure @ 20,000/- p.m. for 20 months . . . . .	4,00,000
	<hr/> 5,83,360

Total for Geological surveys . . . . .	16,69,360
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(VIII) *Communications*

Lump Sum . . . . .	1,00,000
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TOTAL OF WORKS . . . . .	34,11,815
2% Contingencies . . . . .	70,236
GRAND TOTAL WORKS . . . . .	<hr/> 34,82,055

## II. TOOLS AND PLANTS

(a) *Camp equipage*

8 tents 14' x 14' @ 1200/- each . . . . .	9,600
20 tents 10' x 10' @ 800/- each . . . . .	16,000
20 shoolaries @ 600/- each. . . . .	12,000
20 servants tents @ 500/- each . . . . .	10,000
Camp furniture . . . . .	4,800
	<hr/> 52,400

(b) *Other tools and plants*(i) *Non-recurring*

15 3/4 ton weapon carrier trucks @ 7000/- each . . . . .	1,05,000
6 jeeps with trailers @ 7000/- each . . . . .	42,000
8 outboard motors @ 1000/- each . . . . .	8,000
32 levelling instruments @ 1000/- each . . . . .	32,000
32 measuring chains @ 50/- each . . . . .	1,600
32 100 ft. tapes @ 30/- each . . . . .	960
32 50 ft. tapes @ 20/- each. . . . .	640
6 Theodolites @ 2000/- each . . . . .	12,000
10 binoculars @ 300/- each . . . . .	3,000
15 drawing boards @ 30/- each . . . . .	450
15 plane tables @ 150/- each . . . . .	2,250
12 Prismatic compass @ 150/- each . . . . .	1,800
3 Planimeters @ 500/- each . . . . .	1,500
24 drawing instrument boxes 2nd class @ 200/- each . . . . .	4,800
Scales with offsets, French curves etc. . . . .	600
	<hr/> 2,16,600

(ii) *Recurring expenditure.*

Repairs and carriage of scientific instruments for 3 years . . . . .	37,500
Running expenses for trucks and jeeps for 3 years . . . . .	1,12,500
	<hr/> 1,50,000

Total (a) and (b) Tools and Plants . . . . . 

---

4,19,000

2% Contingencies . . . . . 

---

8,380

Grand Total Tools and Plants . . . . . 

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4,27,380

## III. ESTABLISHMENT

(Provision for 3 years).

1 Superintending Engineer @ 1850/- p.m. . . . .	66,600
2 Executive Engineers @ 800/- p.m. . . . .	57,600
4 Asst. Executive Engineers @ 600/- p.m. . . . .	86,400
4 Asstt. Engineers @ 500/- p.m. each . . . . .	72,000
1 Superintendent @ 300/- p.m. . . . .	9,600
2 Head Clerks @ 200/- p.m. each . . . . .	14,400
2 Accountants @ 200/- p.m. each . . . . .	14,400
1 Stenographer @ 200/- p.m. each . . . . .	7,200
13 Upper Division clerks including S. D. Cs. @ 100/- p.m. each . . . . .	46,800
23 Lower Division clerks @ 75/- p.m. each . . . . .	62,100
2 Steno-typists @ 100/- p.m. each . . . . .	7,200
1 Head Draftsman @ 300/- p.m. . . . .	9,600
2 Senior Draftsmen @ 100/- p.m. each . . . . .	11,520
6 Draftsmen @ 100/- p.m. each . . . . .	21,600
6 Tracers @ 75/- p.m. each . . . . .	16,200
32 Overseers @ 150/- p.m. each . . . . .	1,72,800
2 Sub-Asstt. Surgeons @ 150/- p.m. each . . . . .	9,600
4 Research Asstts. @ 180/- p.m. each . . . . .	25,920
4 Silt Analysts @ 180/- p.m. each . . . . .	14,400
4 Laboratory Asstts. @ 125/- p.m. each . . . . .	18,000
2 Compounders @ 75/- p.m. each . . . . .	4,800
2 ward boys @ 50/- p.m. each . . . . .	3,600
1 Jemadar @ 40/- p.m. . . . .	1,440
21 peons @ 30/- p.m. each . . . . .	22,680
44 Barkandaz @ 30/- p.m. each . . . . .	47,520
10 Daffadars @ 30/- p.m. each . . . . .	10,800
1 Dafftri @ 40/- p.m. . . . .	1,440
	<hr/> 8,40,300
Dearness allowance @ 25% . . . . .	2,10,075
Travelling allowance . . . . .	1,80,000
Establishment contingencies including office furniture, typewriters etc. . . . .	1,80,000
	<hr/> TOTAL ESTABLISHMENT . . . . . <hr/> 14,10,375

(Sd) K. M. BHATIA 3-5-1948.  
Project Officer, I.C.W

## APPENDIX VIII ASSAM PROJECTS REPORT

Assam, the eastern most Province of India, covers an area of 63,000 square miles and gets an annual precipitation of 286 million acre feet. It has tremendous water power potential and a vast scope for industrialisation from its mineral and forest wealths. It suffered a strategic strain during the last war and with partition has become still more important and therefore needs an industrial development allround.

The Province can roughly be divided into 2 main valleys, the Brahmaputra valley in the north and the Surma valley in the south. The waters of these rivers at present cause devastating floods, destroying crops, water logging lands and creating problems of soil erosion and denudation. At the instance of the Government of Assam, the Central Waterpower, Irrigation and Navigation Commission undertook a preliminary survey for multipurpose schemes to solve the above problems as well as to provide cheap power for industrialisation. The available data which is very meagre showed that 12 schemes, 3 in the Surma valley and 9 in the Brahmaputra valley could be mooted. Of these 4 schemes on the Barak and Someshwari rivers in the Surma valley and Dihang and Manas rivers in the Brahmaputra valley were entrusted for investigation to the Central Waterpower, Irrigation and Navigation Commission at a conference held by His Excellency the Governor of Assam in October, 1947.

The Central Waterpower, Irrigation and Navigation Commission started investigations on these four schemes in January, 1948, and two of the rivers Dihang and Barak have been inspected by an Engineer, Dihang having been inspected by a Geologist also. The inspection has shown that schemes on both the rivers are promising.

The four schemes are briefly described below in order of priority and their principal features are shown in the accompanying statement.

1. *Dihang*.—It is the main tributary of the Brahmaputra and possesses 2 excellent storage sites within 13 miles of its debouch from the hills. A 500 feet dam will impound lake of 9.82 million acre feet and generate at least one million k. w. of continuous power. The scheme will provide for flood absorption by storing the supply of the main tributary at times of rain thereby releasing the capacity of Brahmaputra in the lower basin to absorb floods from other tributaries. The lake will be 70 miles long and help in opening up the tribal areas of Assam.

2. *Barak*.—Barak rises in the hills of Manipur State, bifurcates into two estuaries the Surma and the Kusiya, which both fall into the Meghna river. When Meghna is in floods, its back water effect interrupts drainage of the Surma Valley with the result that the plains of Cachar and Sylhet districts become almost one sheet of water. A storage scheme on this river would absorb floods thereby reclaiming the plains of Surma Valley from water-logging and will provide irrigation to the reclaimed areas as also generate about 2,90,000 h.p. of power, which can be used in industrial exploitation of the tremendous forest wealth of Manipur and Lushai hills. As these hills are of shaly formations, 3 alternate schemes as shown in the statement have to be investigated.

3. *Manas*.—Manas is the largest tributary of the Brahmaputra at the western end of Assam. The river is snow cum rain fed and large icebergs are reported now and again to form artificial dams in the river and cause unexpected floods when any one of them gives way. A 400 feet high dam will solve this flood problem, generate 2,50,000 k. w. of continuous power and provide irrigation to the western areas of Assam. The Government of India have under consideration a project for a navigation canal between Ganges, Tista and Brahmaputra to provide water transport between Assam and West Bengal. The Manas project will shorten one of the links in the development of this canal as it will make Manas navigable throughout the year and the canal can be connected with Brahmaputra through Manas.

4. *Someshwari*.—Someshwari river provides a site for power generation at the southern fringe of Garo hills. The river has a catchment area of 803 square miles and a 340 ft. high dam will store the entire run off. There are rich coal fields and purest limestone quarries near this site and the power generated is expected to help in the development of those industries.

To enable these 4 schemes to be put through, detailed investigations covering topographical surveys of reservoir areas, surveys for irrigation, hydrological surveys, meteorological observations, geological surveys, navigational surveys, soil conservation surveys and pisciculture surveys have to be undertaken. It is proposed to open up a Circle with 3 Divisions and 9 sub-divisions to carry out these investigations and complete them in a period of 3 years. Besides the civil staff, the geological staff and the meteorological staff have been provided and the total estimate for the investigations amounts to Rs. 50,00,000.

5. Index map showing dam sites etc. is enclosed.

K. M. BHATIA,  
Project Officer  
C.W.I.N.C.—3.5. 1948.

## ROUGH DATA FOR DAM SITES IN ASSAM PROVINCE

S. No.	Name of Tributary	Name of nearest village	Longitude and Latitude of left bank of dam site	Map in which dam and water spread fall	Approximate catchment area in sq. miles	Maximum water level	Approx. height of F. T. L. over river level in feet	Approx. length of water spread at M. W. L. at dam site in miles	Submerged area in acres	Approx. length of dam in feet	Capacity of in m.a.f.	Average rain-fall for 11 years (Inches)	Run off as per Inglis formula (at 50 %) Million acres ft.	Power potential Q. H. $\frac{1}{15}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Dihang.	Rengging.	95°-14'-30" E	82/P. L.	89,600	1,000	470	68	60,000	1900	9.82	170.43	56.08 1 million k w.	
2	Manas	Matharguri	28°-11'-30" N										54.18	
			90°-56'-30" E										46.94 240000 k.w	
3	Someshwari	Masighat.	26°-48'-30" N	78/J. M. N.	11,300	1,000	400	34	64,700	1900	10.67	105.73	31.86	
			90°-38'-30" E	78K/S. E.									4.85 65000 k. w.	
4(I)	Barak	Sibapurikhal	25°-13'30" N	83H/N. W.	800	400	330	29	33,200	2000	4.75	125.14	2.67	
			93°-3' E										17.9 290000 k.w.	
4(II)	Barak.	Bhubandhar.	24°-32' N	N.E.S.W.S.E.	4,800	500	440	129	89,600	4000	16.00	82.10	10.5	
			93°-12'-30" E	83H/N.W.S.W.									19.5 225000 k.w.	
4(III)A	Barak.	Bhubandhar.	24°-41'-0" N	83/N.W.S.W.	5,270	400	340	108	94,000	4000	15.15	82.10	11.6	
			93°-6'-0" E										19.5 116000 k.w	
4(III)B	Ahu	Tingmum	24°-41'-0" E	83H/N. W.	5,270	300	240	88	58,300	4000	7.19	82.10	11.6	
			93°-6'-0" E										5.44 21000 k w.	
4(III)C	Irang & Tinjang	Gallon.	24°-41'-30" N	83H/S. W.	1,475	450	250	31	6,700	2000	0.74	82.10	3.22	
			93°-15'-0" E										5.3 21000 k.w.	
			24°-30'-30" N	N. W.	1,440	450	260	28	7,000	2000	0.93	82.10	3.15	

\*Inglis formula is given as  $R'' = 0.85P'' - 12''$

overall estimate for preliminary surveys and investigations for four projects in Assam.

# ABSTRACT

Period of investigation . . . . .	3 years.
Detailed estimate as prepared and submitted to W. M. P. for 15 months operations—	
(Establishment provided for 12 to 14 months) . . . . .	23.08 lacs.
Deduct non-recurring cost . . . . .	10.3 lacs.
	<hr/> 12.78 lacs.
Assume 3 times this cost for 3 years operations . . . . .	38.4 lacs.
Add non-recurring cost . . . . .	10.3 lacs.
	<hr/>
Total . . . . .	48.7 lacs.
Say . . . . .	<hr/> 50 lacs.

(Sd.) K. M. Bhatia—3-5-1948

Project Officer. C. W. I. N. C.

Rough estimates of preliminary investigations of the Assam Projects for the years 1947-48 and 1948-49.

# ABSTRACT

	1947-48 Rs.	1948-49 Rs.
1. Surveys by Survey of India Department . . . . .	10,000	4,00,000
2. Surveys by C. W. I. N. C. . . . .	5,000	1,10,000
3. Discharge observations (4 sites) . . . . .	2,500	30,000
4. Silt Observations . . . . .	2,000	23,000
5. Property surveys . . . . .	Nil	10,000
6. Meteorological Surveys . . . . .	..	40,000
7. Seismological Surveys . . . . .	..	20,000
8. Geological investigations . . . . .	..	8,00,000
9. Communications . . . . .	..	25,000
10. Temporary buildings . . . . .	..	25,000
11. Camp equipage . . . . .	20,000	10,000
12. Tools and Plants . . . . .	1,00,000	80,000
13. Establishment . . . . .	40,000	2,40,000
14. Dearness allowance . . . . .	16,000	96,000
15. Travelling allowance . . . . .	12,000	72,000
16. Office contingencies . . . . .	60,000	60,000
Total . . . . .	<hr/> 2,67,500	<hr/> 20,41,000

NEW DELHI;

18-11-47.

MAN SINGH,

Director of Waterways, C. W. I. N. C.

# DETAILS

	Rs.	Rs.
I. Surveys to be carried by Survey of India Department under direction of the C. W. I. N. C.—		
(a) Gorge sites 25 sq. miles @ 110/- per sq. mile . . . . .	2,750	..
River survey 1,000 sq. mile @ Rs. 44/- per sq.m. . . . .	44,000	..
Moving aircraft, etc. . . . .	3,250	..
(b) Surveys and map publications.—		
Gorge sites 5,000 acres @ 4/- per acre . . . . .	20,000	..
River Survey 900 sq. miles @ 160/- per sq. mile . . . . .	1,44,000	..
	<hr/> 1,64,000	..
(c) Contoured surveys of Assam projects flood plain in Assam for Irrigation and other protective measures, 3,48,000 acres @ -/9/- per acre . . . . .	1,96,000	4,10,000
II. Survey to be carried out by or under direction of the C. W. I. N. C.—		
(a) Longitudinal Sections of rivers and cross sections, 650 miles @ 150/- per mile . . . . .	97,500	..
(b) Other miscellaneous surveys e.g. canal alignment, special reservoir surveys, etc. . . . .	17,500	1,15,000

## III. Discharge observations.—

Number of sites 4

## Expenditure per site. Equipment Non-recurring.—

1 current meter @ 1,200/- . . . . .	1,200	
1 boat large @ 1,000/- . . . . .	1,000	
1 boat small @ 500/- . . . . .	500	
Velocity rods . . . . .	200	
Sounding rods . . . . .	100	
Ropes, etc. . . . .	600	
Chronometers . . . . .	200	
	<hr/>	
	3,800	
	<hr/>	

## Recurring expenditure.—

Provision is made for 12 months.—

1 supervisor @ 150/- p. m. . . . .	1,800	
1 Boatman @ 40/- p. m. . . . .	480	
4 Khalasis (also suitable as Boatmen) @ 30/- p. m. . . . .	1,440	
T. A., etc . . . . .	605	
	<hr/>	
	4,325	
	<hr/>	

4 Sites equipment @ 3,800 per site . . . . .	15,200	
4 Sites recurring expenditure @ 4,325/- per site . . . . .	17,300	32,500

## IV. Silt observation at the above 4 sites.—

One silt observer and one analyst are proposed to be employed for taking observations at each site.

## (i) Equipment non-recurring..

Apparatus. 4 sets . . . . .	4,000	4,000
-----------------------------	-------	-------

## (ii) Recurring expenditure.—

Provision is made for 12 months.

4 silt observers @ 100/- p. m. each . . . . .	4,800	
4 silt analysts @ 100/- p. m. each . . . . .	4,800	
Khalasis (4 per observer and 2 per analysts) 24 @ 30/- p. m. each . . . . .	8,640	
Dearness and Travelling allowance . . . . .	2,760	21,000

## V. Property Surveys.—

1 Supervisor for 12 months @ 110/- p. m. . . . .	1,320	
4 Surveyors for 12 months @ 80/- p. m. . . . .	3,800	
12 Khalasis for 12 months @ 30/- p. m. . . . .	4,320	
Patwaris Lump Sum . . . . .	560	

## VI. Meteorological Surveys. (Rain gauges and Snow courses). It is proposed to install 50 new gauge stations.

## (i) Equipment installation of gauges non-recurring.—

50 rain gauges (including temperature, 25,000 humidity and wind velocity at 25 places, also some self recording gauges) average rate of say 500/- each . . . . .	25,000	
Miscellaneous apparatus snow samples etc. . . . .	4,000	29,000

## (ii) Recurring expenditure.—

Provision is made for 12 months.

1. Meteorological Assistant @ 200/- . . . . .	2,400	
1 Senior observer @ 120/- p. m. . . . .	1,440	
16 Observers, (part time) @ 15/- p. m. . . . .	2,880	
16 Retainers (part time) @ 12/- p. m. . . . .	1,536	
2 snow surveyors @ 120/- p. m. . . . .	2,880	
	<hr/>	
	40,136	Say 40,000

## VII. Seismological Surveys.

This will be taken up separately in consultation with the Director of Meteorological Surveys but a lump sum provision is made of Rs. 20,000/-.

## VIII. Geological Investigations.—

## (i) Equipment non-recurring.—

4 Diamond Drill with equipment complete @ 75,000/- each . . . . .	3,00,000	
Diamonds (and other spares) for the above @ 40,000/- each . . . . .	1,60,000	
1 Calyx Drill 5"—6" complete with equipment, etc.. . . . .	20,000	
Spare for above . . . . .	5,000	
4 special boats for drills @ 2,000/- each . . . . .	8,000	
Testing apparatus for rocks and rock materials . . . . .	47,000	5,40,000

## (ii) Recurring expenditure.—

1 Geologist @ 600/- p. m. for 15 months . . . . .	9,000	
2 Asstt. Geologists @ 300/- each for 15 months . . . . .	9,000	
1 Drill Foreman @ 1,000/- p. m. for 12 months . . . . .	12,000	
4 Operators (1 per drill) @ 140/- p. m. each for 12 months . . . . .	6,720	
24 helpers (6 per drill) @ 80/- p. m. for 12 months . . . . .	23,040	
Running expenses of 4 engines for drills for 10 months @ 5,000/- per drill . . . . .	2,00,000	any 2,60,000

IX. *Communications—*

Lump Sum . . . . .	25,000	5,000
<i>Temporary buildings.—</i>		
Lump Sum . . . . .	25,000	25,000

XI. *Camp equipage.—*

4 tents 14' × 14' @ 1,200/- each . . . . .	4,800	
12 tents 10' × 10' @ 800/- each . . . . .	9,600	
12 shouldaries @ 600/- each . . . . .	7,200	
12 servants tents @ 500/- each . . . . .	6,000	
Camp furniture . . . . .	2,000	29,800

XII. *Tools and plants—*(i) *Non-recurring—*

13 trucks @ 7,000/- each . . . . .	91,000
4 jeeps @ 7,000/- each . . . . .	28,000
4 country boats @ 1,000/- each . . . . .	4,000
4 outboard motors @ 1,000/- each . . . . .	4,000
8 Chronographs @ 100/- each . . . . .	800
24 levelling instruments @ 1,000/- each . . . . .	24,000
Measuring chains 24 @ 15/- each . . . . .	360
26—100' tapes @ 30/- each . . . . .	780
30—50' tapes @ 20/- each . . . . .	600
4 Theodolites @ 1,200 /- each . . . . .	4,800
6 Binoculars @ 200/- each . . . . .	1,700
12 drawing instrument boxes 2nd class @ 200/- each . . . . .	2,400
Scales with offsets, French curves . . . . .	500
12 Drawing Boards @ 30 each . . . . .	360

1,64,000

(ii) *Recurring expenditure.—*

Repairs . . . . .	4,000
Working of trucks . . . . .	12,000

XIII. *Establishment—*

(Provision is made for 14 months).

3 Executive Engineers @ 600/- p. m. each . . . . .	25,000	
9 Assistant Engineers (S. D. Os.) @ 350/- p. m. each . . . . .	44,100	
1 Superintendent @ 250/- p. m. . . . .	3,500	
3 Head Clerks @ 160/- p. m. each . . . . .	6,720	
1 Stenographer @ 160/- p. m. . . . .	2,240	
3 Accountants @ 150 p. m. each . . . . .	6,300	
3 Upper grade clerks @ 80/- p. m. each . . . . .	3,360	
3 Accounts clerks @ 80/- p. m. each . . . . .	3,360	
9 Sub-divisional clerks @ 80 p. m. each . . . . .	10,080	
3 Steno-typists @ 80/- p. m. each . . . . .	3,360	
4 Lower grade clerks @ 55/- p. m. each . . . . .	3,080	
3 Record Keepers @ 55/- p. m. each . . . . .	2,310	
6 Assistant Accounts Clerks @ 55/- p. m. each . . . . .	4,620	
9 Assistant Sub-divisional clerks @ 55/- p. m. each . . . . .	6,930	
3 Assistant Record keepers @ 55/- p. m. each . . . . .	2,310	
2 typists @ 55/- p. m. each . . . . .	2,310	
3 despatchers @ 55/- p. m. each . . . . .	2,310	
1 Head draftsman @ 300/- p. m. . . . .	4,200	
3 Senior draftsmen @ 170/- p. m. each . . . . .	7,140	
8 draftsmen @ 100/- each . . . . .	11,200	
3 Overseers (Headquarters) @ 100/- p. m. each . . . . .	4,200	
8 Tracers @ 60/- p. m. each . . . . .	6,720	
36 Overseers @ 100/- p. m. each . . . . .	50,400	
6 Research Assistants @ 160/- p. m. each . . . . .	13,440	
5 Silt Analysts @ 100/- p. m. each . . . . .	7,000	
3 Sub-Assistant Surgeons @ 100/- p. m. each . . . . .	4,200	
3 Compounders @ 40/- p. m. each . . . . .	1,680	
3 Ward boys @ 30/- p. m. each . . . . .	1,260	
1 Jemadar @ 35/- p. m. each . . . . .	490	
27 Peons @ 30/- p. m. each . . . . .	11,340	
12 Dafadars @ 30/- p. m. each . . . . .	5,040	
24 Barkandaz @ 30/- p. m. each . . . . .	10,080	
1 Daftri @ 35/- p. m. . . . .	490	2,79,930
		say 2,80,000
(b) <i>Dearness and Travelling allowances.—</i>		
Lump Sum . . . . .	1,96,000	1,96,000

XIV. *Contingencies—*

Lump Sum . . . . .	1,20,000	1,20,000
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*Estimate for preliminary surveys and investigations in connection with the projects in Assam Province prepared in accordance with the instructions of the AD-HOC Committee.*

### ABSTRACT

1. Surveys by Survey of India . . . . .	6,16,500
2. Surveys by C. W. I. N. C. . . . .	1,50,000
3. Discharge observations . . . . .	57,780
4. Silt Observations . . . . .	26,000
5. Property Survey . . . . .	9,600
6. Meteorological Survey . . . . .	60,800
7. Seismological Survey . . . . .	25,000
8. Geological Survey . . . . .	8,53,280
9. Communications Lump Sum . . . . .	50,000
10. Buildings Lump Sum . . . . .	50,000
11. Camp equipage . . . . .	29,600
12. Tools and Plants . . . . .	2,80,170
13. Establishment . . . . .	8,65,000
Total . . . . .	30,73,710

### DETAILS

#### I. Surveys to be carried out by Survey of India—

(i) Air photography of gorge sites 1,25,000 acres (200 sq. miles) @25 per sq. mile. . . . .	5,000
(ii) River survey. 5 mile strip for length of 2 lakes and reservoir upto its junction with Brahmaputra. $202 \times 5 = 1,010$ Say 1,000 sq. mile @ Rs. 44 per sq. mile . . . . .	44,000
(iii) Moving aircraft . . . . .	5,000
(b) Field Surveys and Publications—	
(i) Reservoir sites 200 sq. mile @ 375 per sq. mile . . . . .	75,000
(ii) River area 1,000 sq. mile @ 375 per sq. mile . . . . .	3,75,000
(iii) Irrigation potential on Manas 2,00,000 acres @ -/9/- per acre . . . . .	1,12,500
	6,16,500

#### II. Survey to be carried out by C. W. I. N. C.—

(a) Longitudinal sections of rivers 200 miles @ 150 per mile . . . . .	30,000
(b) Other miscellaneous surveys like canal alignment, special reservoir, pisciculture, etc. . . . .	1,20,000
	1,50,000

#### III. Discharge Observations —

Number of sites 4 (2 for projects and 2 more for hydrological data for Barak and Someshwari).

##### (a) Equipment expenditure non-recurring—

1 Current meter @ 1,200 . . . . .	1,200
1 Boat large @ 1,000 . . . . .	1,000
1 Boat small @ 500 . . . . .	500
1 Set sounding rods @ 100 . . . . .	100
Ropes, etc. . . . .	600
Chronometers . . . . .	200
Rack and Pinion arrangement . . . . .	200
	4,000

(b) *Recurring—*

1 Gauge reader @ 75 for 2 years . . . . .	1,800
1 boatman @ 60 for 2 years . . . . .	1,440
6 Khalasis @ 50 for 2 years . . . . .	7,200
	<hr/>
	10,440
	<hr/>
Total for one site . . . . .	14,440
Total for 4 sites . . . . .	57,760
	<hr/>

IV. *Silt Observations—*

(i) Equipment non-recurring @ 1,000/- per site. . . . .	4,000
(ii) 4 Silt observers and Analysts @ 100/- for 2 years . . . . .	9,600
(iii) 8 Khalasis @ 50/- for 2 years . . . . .	9,600
(iv) Miscellaneous on carriage and Transport . . . . .	2,800
	<hr/>
	26,000
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V. *Property Survey—*

1 Surveyor @ 100/- for 2 years . . . . .	2,400
6 Khalasis @ 50/- for 2 years . . . . .	7,200
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	9,600
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VI. *Meteorological survey (rain gauges and snow courses) —*

(i) 50 more rain gauges as proposed to be installed (in Barak & Someswar) giving one gauge for 4000 sq. miles @ 500/- . . . . .	25,000
Snow survey apparatus . . . . .	7,500
(ii) <i>Recurring expenditure—</i>	
1 Meteorological Assistant @ 200/- for 2 years . . . . .	4,800
1 Senior observer @ 120/- for 2 years . . . . .	2,880
16 Observers @ 20/- for 2 years (part-time) . . . . .	7,680
16 Retainers (part time) @ 15/- for 2 years . . . . .	5,760
2 Snow surveyors @ 150/- for 2 years . . . . .	7,200
	<hr/>
	60,820
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VII. *Seismological Survey—*

Lump Sum . . . . .	25,000
	<hr/>

VIII. *Geological Survey—*

(i) <i>Equipment non-recurring —</i>	
4 Diamond Drills @ 75,000/- each . . . . .	3,00,000
Diamonds and other spares @ 40,000/- per set . . . . .	1,60,000
1 Calyx drill 5"—6" complete with equipment and spares . . . . .	25,000
4 Special boats for drills @ 2,000/- each . . . . .	8,000
Testing apparatus for rocks and rock material . . . . .	47,000
	<hr/>
	5,40,000
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(ii) <i>Recurring expenditure—</i>	
1 Geologist @ 800/- for 2 years . . . . .	19,200
1 Asstt. Geologist @ 400/- for 2 years . . . . .	9,600
1 Drill Foreman @ 1,000/- for 2 years . . . . .	24,000
4 Operators (1 per drill) @ 150/- for 2 years . . . . .	14,400
24 Helpers (6 per drill) at 80/- for two years . . . . .	46,080
Fuel and other running expenses @ 10,000 p. m. per drill for 20 months . . . . .	2,00,000
	<hr/>
	3,13,280
	<hr/>
Total . . . . .	8,53,280
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IX. *Communications—*

Lump sum . . . . .	50,000
	<hr/>

X. *Temporary buildings—*

Lump sum . . . . .	50,000
	<hr/>

XI. *Camp equipage—*

4 tents 14' × 14' @ 1,200/- each . . . . .	4,800
12 tents 10' × 10' @ 800/- each . . . . .	9,600
12 shouldaries @ 600/- each . . . . .	7,200
12 servants tents @ 500/- each . . . . .	6,000
Camp furniture . . . . .	2,000
	<hr/>
	29,600

XII. *Tools and Plants—*(i) *Non-recurring.*

13 trucks @ 7,000/- each . . . . .	91,000
4 jeeps @ 7,000/- each . . . . .	28,000
4 out board motors @ 2,000/- each . . . . .	8,000
24 levelling instruments @ 1,000/- each . . . . .	24,000
24 measuring chains @ 15/- each . . . . .	360
24 metallic tapes @ 30/- each . . . . .	720
4 Theodolites @ 2,000/- each . . . . .	8,000
8 Binoculars @ 300/- each . . . . .	2,400
18 Drawing boards @ 30/- each . . . . .	540
18 drawing instruments 2nd size @ 200/- each . . . . .	3,600
3 planimeters @ 500/- each . . . . .	1,500
15 plane tables @ 150/- each . . . . .	2,250
12 nos. Prismatic compass @ 150/- each . . . . .	1,800
Other miscellaneous drawing apparatus like set squares, scales, curves . . . . .	8,000
	<hr/>
	1,80,170

(ii) *Recurring expenditure—*

Repairs and carriage of scientific instruments for 2 years . . . . .	25,000
Running expenses for trucks and jeeps for 2 years . . . . .	75,000
	<hr/>
	1,00,000
	<hr/>
	2,80,170

XIII. *Establishment—**Provision for 24 months—*

1 Superintending Engineer @ 1,850/- for 24 months . . . . .	44,400
2 Executive Engineers @ 800/- p. m. each . . . . .	38,400
6 Assistant Engineers @ 400/- p. m. each . . . . .	57,600
1 Superintendent for Circle Office @ 300/- p. m. . . . .	7,200
1 Head Draftsman for Circle Office @ 300/- p. m. . . . .	7,200
1 Stenographer for Circle Office @ 200 p. m. . . . .	4,800
2 Head Clerks for Executive Engineers Offices @ 200/- p. m. each . . . . .	9,600
2 Accountants for Executive Engineers Offices @ 200/- p. m. each . . . . .	9,600
13 upper grade clerks including Sub-divisional clerks @ 100/- each . . . . .	31,200
2 Stenographers to Executive Engineers @ 100/- p. m. each . . . . .	4,800
23 lower grade clerks including recordkeepers and typists @ 75/- p. m. each . . . . .	41,400
6 Draftsmen @ 100/- p. m. each . . . . .	14,400
6 Tracers @ 75/- p. m. each . . . . .	10,800
24 Overseers @ 150/- p. m. each . . . . .	86,400
4 Research Assistants @ 200/- p. m. each . . . . .	19,200
4 Laboratory Assistants @ 75/- p. m. each . . . . .	7,200
2 Sub-Assistant Surgeons @ 150/- p. m. each . . . . .	7,200
3 compounders @ 50/- p. m. each . . . . .	3,600
2 ward boys @ 50/- p. m. each . . . . .	2,400
1 Steno to Geologist @ 100/- p. m. . . . .	2,400
1 clerk to Geologist @ 75/- p. m. . . . .	1,800
3 daftaris @ 40/- p. m. each . . . . .	2,880
1 Jemadar to S. E. @ 40/- p. m. . . . .	960
21 peons (8 per Division = 16) } @ 30/- p. m. each . . . . .	15,120
Circle Office—3	
Geologist and Assistant—2	
36 Barkandazes @ 30/- p. m. each . . . . .	25,920
10 dafadars @ 30/- p. m. each . . . . .	7,200
	<hr/>
	4,71,360

Say . 4,72,000

Dearness allowance @ 25% . . . . .	1,18,000
Travelling allowance . . . . .	1,50,000
Establishment contingencies including office furniture, Typewriters, etc. . . . .	1,25,000

Total Establishment . 8,65,000

(Sd.) K. M. BHATIA,

Project Officer, C. W. I. N. C.

3-5-1948.

## APPENDIX IX

### COORG PROJECT

#### REPORT

The province of Coorg is a small centrally administered area in South India, west of Mysore State. The total area is 1,582 square miles and population of less than 2,00,000. It receives an annual rainfall of about 125". A number of schemes for irrigation and hydro-electric generation were projected by the provincial engineers in the past, but all of them were shelved for one reason or another. A small province like Coorg cannot take up independently investigations, preparation, and execution of such large scale projects for the development of its water and power resources.

C.W.I.N.C. was, therefore, approached by the Chief Commissioner of Coorg to take up the investigations of the feasible projects in the province, and also to take up the question of renovation of existing irrigation and fish culture tanks. Director Irrigation and Assistant Director toured Coorg in October last, and inspected most of the sites. As a result of the inspection, the three projects—Herangi, Barapole and Lakshman. tirtha, were considered suitable for investigations. Main features of these projects are given below (See Index Map) :—

*Herangi Project.*—This project was first conceived in 1877 on representation of an influential zamindar of the place who drew attention to the possibility of utilising the Herangi river as a source of irrigation. A scheme prepared in 1899 for an anicut across Herangi near Herur village was later on abandoned as it was considered unremunerative. Similar attempts at reviving the project were also unsuccessful and the scheme was later on shelved. In order to make it a paying project, a dam with possibility of hydel energy along with irrigation is envisaged. A suitable site near the boundary of Herangi and Halgunda villages in the narrow gorge has now been located and is considered suitable for about 100' high dam. It would be affording irrigation to about 7,000 acres and generate about 1,800 kws of continuous power.

*Barapole Project.*—This project envisages two dams about 100'—150' high, one each on Konganahole and Kokatahole, the two tributaries of the Barapole river, and through pipes leading the discharge about 4 miles away, so that a head of about 1500' is available for power. The total power available from these two dams is estimated to be about 47,700 KWs of firm power. The power can be utilised in Madras Presidency for the adjoining districts of Malabar and South Kanara which are in need of it. It will also give impetus to new industries being started in Coorg province itself.

*Lakshmantirtha Project.*—This project originally prepared in 1941 consists in having an anicut across Lakshmantirtha river just below its confluence with Ramtirthahole. The anicut will supplement water required to irrigate about 3,000 acres in Coorg province. The execution of the project was however objected to by the Mysore Government as in their view it would have had detrimental effect on the existing irrigation lower down the river in Mysore territory. To speed up agreement it is proposed to hold a meeting of the engineering representatives of the C.W.I.N.C., Madras Government and Mysore Government to go into the question whether it would be possible to allow the construction of an anicut, or it would be necessary to provide storage at the site. Survey and investigation work will have to be done for either project.

An overall estimate of Rs. 6,64,700 has been framed to carry out the surveys and investigations work on all the three projects, and to put up proposals for renovation of irrigation tanks. Surveys of the reservoir areas and dam sites provided in the estimate are proposed to be carried out by the survey of India Department, whereas the surveys for the irrigation areas would be done by the C.W.I.N.C. staff. Property surveys, electric load surveys and mineral surveys have also been included in the estimate. Geological investigations, including boring and drilling in the abutments and foundation, are proposed to be carried out in conjunction with the Geological Department and have been adequately provided for in the estimate. Fixing of new rain gauges, temperature and humidity recording stations shall be set up and read by the Meteorological Department. Discharge and silt observations are proposed to be recorded regularly and have been provided for in the estimate. To carry out these investigations it is proposed to open one division with three sub-divisions along with the requisite staff for two years, the time which it is estimated the work will take to complete. Necessary provision for this has been made in the estimate. Provision has also been made for the purchase of necessary office equipment, scientific and ordinary tools and plants, and motor vehicles etc. It is also proposed to house the entire staff in temporary buildings for the duration of the investigations.

M. D. MITHAL,

Director, Irrigation & Waterways.

C. W. I. N. C.

*Overall estimate for preliminary surveys and investigations of Irrigation and Hydel  
Projects in the Coorg Province*

**ABSTRACT**

	Rs.
I. WORKS	2,11,260
II. TOOLS AND PLANT	1,14,240
III. ESTABLISHMENT	3,39,240
<b>Total</b>	<b>6,64,740</b>

**DETAILS**

**I. Works—**

(i) *Dams and Appurtenant Works*

Preliminary Expenses :—

1. Survey of the reservoir basin by air photography and ground survey and plotting contours @ 10'—5ft. intervals on a scale of 4"=1 mile	
10 sq. miles @ Rs. 375/-per sq. mile	3,750
2. Survey of the Dam sites and weir site by air Photography and ground surveys and plotting on a scale of 32"=1 mile	
1,280 acres @ Rs. 4/- per acre	5,120
3. Geological investigations of foundations of the dams and weir sites including boring, core drilling, drifts etc :	
Kokatahole dam	15 Nos.
Konganahole dam	15 Nos.
Herangi dam	15 Nos.
Lakshmantirtha weir	5 Nos.
	50 Nos.
50 Nos. each of 50'-2500 ft. @ Rs. 20/- per foot	50,000
4. Soil Analysis for earthen dam etc.	2,000

(II). *Buildings :*

Temporary Buildings	5,000
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(III). *Main Canals and branches :—*

1. Surveys of the commanded areas for alignment of canals :	
Herangi.	7,000 acre
Lakshmantirtha	3,000 acres.
	10,000 acres
10,000 acres @ 1/2/- per acre	11,250
2. Miscellaneous surveys	4,000
3. Longitudinal section of the rivers and its tributaries 40 miles @ Rs. 25/- per mile	1,000

(IV). *Discharge and silt observations.*

One boatman and 4 Khalasis at each discharge site, cost of ropes, discharge rods, floats etc. included.	
3 sites @ Rs. 5,000/- per site per year for 2 yrs.	30,000

(V) *Meteorological Observations.*

Raingauges, temperature, humidity etc. observations L.S.	2,000
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(VI). *Mineral surveys* . . . . . L.S. . . . . 2,000

(VII). *Electric load surveys* . . . . . L.S. . . . . 10,000

(VIII). *Economic and Property surveys* . . . . . L.S. . . . . 5,000

(IX). *Communications* . . . . . L.S. . . . . 5,000

(X). *Special tools and plants.*

1. Diamond drill complete with accessories @ Rs. 60,000 each.	60,000
Testing apparatus and laboratory equipment	11,000
	2,07,120

2% contingencies	4,140
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**2,11,260**

**Total Works** . . . . . **2,11,260**

**II. Tools and Plants.—**

1. Motor vehicles for survey parties 6 Vehicles @ Rs. 7,000 each	42,000
Maintenance for 2 years	20,000
2. Scientific instruments etc.	10,000
3. Ordinary tools and plants	5,000
4. Camp Equipage	15,000
5. Office furniture	15,000
6. R & C of T & P	5,000

1,12,000

2% contingencies	2,240
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**1,14,240**

**Total Tools and Plants** . . . . . **1,14,240**

**III. Establishment.**

1. *Pay of Officers.*

Executive Engineer 1 No. @ Rs. 875/- p.m. for 2 years	21,000
Assistant Engineer 3 Nos. @ Rs. 560/- p.m. for 2 years	40,320
Assistant Geologist @ Rs. 500/- p.m. for 2 years	12,000
Drill foreman @ Rs. 1000/- p.m. for 1 year	12,000

**Rs. 85,320**

**2. Pay of Establishment.—**

Supervisors 12 Nos. @ Rs. 240/- p.m. for 2 years	.	.	.	.	.	.	.	69,120
Accountant 1 No. @ Rs. 200/- p.m. for 2 years	.	.	.	.	.	.	.	4,800
Head Clerk 1 No. @ Rs. 180/- p.m. for 2 years	.	.	.	.	.	.	.	4,320
Clerks 8 Nos. @ Rs. 93/- p.m. for 2 years	.	.	.	.	.	.	.	17,856
Draftsmen 2 Nos. @ Rs. 200/- p.m. for 2 years	.	.	.	.	.	.	.	9,600
Tracers 2 Nos. @ Rs. 104 p.m. for 2 years	.	.	.	.	.	.	.	4,992
Daffadars 1 No. @ Rs. 33 p.m. for 2 years	.	.	.	.	.	.	.	792
Barkandaz 1 No. @ Rs. 33/- p.m. for 2 years	.	.	.	.	.	.	.	792
Peons 8 Nos. @ Rs. 33/- p.m. for 2 years	.	.	.	.	.	.	.	6,322
Khalasis 12 Nos. @ Rs. 33/- p.m. for 2 years	.	.	.	.	.	.	.	9,504
Dak runners 4 Nos. @ Rs. 33/- p.m. for 2 years	.	.	.	.	.	.	.	3,162
								<hr/> Rs. 1,31,260
Dearness allowances for Officers for 2 years lump sum	.	.	.	.	.	.	.	10,000
Dearness allowance for establishment for 2 years lump sum	.	.	.	.	.	.	.	50,000
								<hr/> 60,000
T.A. for officers for 2 years lump sum	.	.	.	.	.	.	.	24,000
T.A. for Establishment for 2 years lump sum	.	.	.	.	.	.	.	32,000
								<hr/> 56,000
								<hr/> Rs. 3,32,580
2 % contingencies	.	.	.	.	.	.	.	6,660
Total Establishment	.	.	.	.	.	.	.	<hr/> Rs. 3,39,240
								<hr/> 3,39,240
Grand Total	.	.	.	.	.	.	.	<hr/> Rs. 6,64,740

M. D. MITHAL,  
*Director, Irrigation & Waterways*  
 C. W. I. N. C.

*Estimate for preliminary surveys and investigation of Irrigation and Hydel Projects  
in the Province of Coorg, which was originally submitted to Government*

**ABSTRACT**

I. WORKS . . . . .	60,000
II. TOOLS AND PLANTS . . . . .	40,000
III. ESTABLISHMENT . . . . .	1,24,000
<b>Total</b>	<b>2,24,000</b>

**DETAILS**

**I. Works.—**

<i>Surveys</i>	<b>Rs.</b>
Surveys of the Reservoir Area 6,000 acres @ Rs. 2/- acre . . . . .	12,000
Irrigation Area, 10,000 acres @ as. 8 per acre . . . . .	5,000
Property, Surveys, etc. . . . .	3,000
<i>Exploration Work—Equipment &amp; Staff.—</i>	
Drilling, boring etc. 4 sites @ Rs 4,000 each . . . . .	16,000
Staff and other geological surveys . . . . .	4,000
<i>Temporary Buildings, Gauge Readers' Huts etc.—</i>	
S. D. O. quarters temporary (alternative tents) (3) at Rs. 2,500/- . . . . .	7,500
Overseer's Huts (12) @ Rs. 750/- . . . . .	9,000
Gauge Readers' Huts etc. . . . .	3,500
<b>Total—Works</b>	<b>60,000</b>

**II. Tools and Plant.—**

Furniture for Divisional and Sub-Division Offices . . . . .	5,000
Camp furniture . . . . .	2,000
Transport vehicle and its maintenance . . . . .	15,000
Instruments Level, Theodolite etc. for surveys . . . . .	10,000
Current meters, boats etc. for discharge and other observations . . . . .	8,000
<b>Total—Tools and Plant</b>	<b>40,000</b>

**III. Establishment.—**

**(a) (1) Pay of Officers —**

1 Executive Engineer for 12 months @ Rs. 900/- p.m. . . . .	10,800
3 Sub-Divisional Officers for 12 months @ Rs. 500/- p.m. . . . .	18,000
<b>Total</b>	<b>28,800</b>

**(2) Pay of Establishment.—**

12 Supervisors for 12 months @ Rs. 150/- p.m. . . . .	21,600
1 Accountant for 12 months @ Rs. 200/- p.m. . . . .	2,400
1 Head clerk for 12 months @ Rs. 160/- p.m. . . . .	1,920
3 clerks for 12 months @ Rs. 80/- p.m. . . . .	7,680
2 Draftsmen for 12 months at Rs. 100/- p.m. . . . .	2,400
2 Tracers for 12 months at Rs. 60/- p.m. . . . .	1,440
1 Dafadar for 12 months at Rs. 30/- p.m. . . . .	360
2 Barkandazes for 12 months at Rs. 30/- p.m. . . . .	720
3 Peons for 12 months at Rs. 30/- p.m. . . . .	2,880
6 Dak runners for 12 months at Rs. 30/- p.m. . . . .	2,160
<b>Total—Establishment</b>	<b>43,560</b>

**(3) Dearness Allowance of Officers—lump sum**

(4) Dearness Allowance, other allowances of Establishment.—lump sum . . . . .	4,000
<b>Total</b>	<b>24,000</b>

**(5) T.A. of Officers . . . . .**

**(6) T.A. of Establishment . . . . .**

(b) Establishment Contingencies . . . . .	6,280
<b>Total—Establishment</b>	<b>1,24,000</b>

**M. D. MITHAL,**  
*Director, Irrigation & Waterways.*  
**C. W. I. N. C.**

## ESTIMATE AS PER INSTRUCTIONS OF AD-HOC COMMITTEE

*Estimate for Preliminary Surveys and Investigations in connection with the Irrigation and Hyee Projects in Coorg Province, prepared in accordance with the instructions of the Ad-Hoc Committee.*

## ABSTRACT

I. WORKS.....	2,02,460
II. TOOLS AND PLANTS.....	79,500
III. ESTABLISHMENTS.....	1,70,040
<b>TOTAL</b>	<b>4,52,000</b>

## DETAILS

## I. Works.—

## i. Dams and appurtenant Works :

## Preliminary Expenses :

1. Surveys of the reservoir basins by air photography and ground survey and plotting contours at 10'—5' intervals on a scale of 4"=1 mile 10 sq. miles @ Rs.375/-p.s.mile	3,750
2. Survey of the damsites and weir sites by air photography and ground surveys and plotting on a scale of 32"=1 mile 1,280 acres @ Rs. 4/- per acre	5,120
3. Geological investigations and foundations of the damsites and weir sites and of the reservoir basins by boring, core-drilling, making drifts and tunnelling etc. including testing :	
Kokatahole dam . . . . . 15 Nos.	
Konganahole dam . . . . . 15 Nos.	
Herangi dam . . . . . 15 Nos.	
Lakshmantirtha weir . . . . . 5 Nos.	
50 Nos.	
50 Nos. each of 50'=2,500' @ Rs. 20/- per foot . . . . .	50,000
4. Soil analysis and burrows surveys for earthen dams including testing L.S. . . . .	2,000

## (ii) Buildings :

Temporary buildings . . . . .	5,000
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## (iii) Main Canals and Branches :

## (a) Survey of the commanded areas for alignment of canals

Herangi . . . . .	7,000 acres
Lakshmantirtha . . . . .	3,000 acres
10,000 acres @ Re-9/- per acre . . . . .	5,525

(b) Miscellaneous Surveys . . . . .	4,000
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## (iv) Discharge and Silt Observations (2 years)

One boatman and four Khalasies at each discharge site, cost of ropes, discharge rods, boats, floats, gauge, silt sampler and Laboratory equipment @ Rs. 5,000/- per site per year 2 sites for 2 years.	30,000
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(v) Meteorological Observations, Rain Gauges, temperature, humidity etc., observations Lump sum . . . . .	2,000
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(vi) Electrical Load Survey L.S. . . . .	10,000
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(vii) Economic and property surveys L.S. . . . .	5,000
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(viii) Communications L.S. . . . .	5,000
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## (ix) Special Tools and Plants :

1 diamond drill complete with accessories @ Rs. 60,000/ each . . . . .	60,000
Testing apparatus and laboratory and workshop equipment for testing of samples . . . . .	11,000

Total . . . . .	1,98,495
2 % contingencies . . . . .	3,975

<b>Total Works</b> . . . . .	<b>2,02,460</b>	<b>2,02,460</b>
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## II. Tools and Plants —

1. Motor vehicles for survey parties . . . . .	25,000
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Running expenses for 2 years . . . . .	10,000
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2. Scientific instruments . . . . .	10,000
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3. Ordinary tools and plants . . . . .	3,000
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4. Camp equipage . . . . .	15,000
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5. Office furniture . . . . .	10,000
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6. R. & C. T. & P. . . . .	5,000
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Total . . . . .	78,000
2 % contingencies . . . . .	1,500

<b>Total—Tools and Plants</b> . . . . .	<b>79,500</b>	<b>79,500</b>
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## III. Establishment—

## 1. Pay of Officers :

Asstt. Engineer 2 @ Rs. 560/- p.m. for two years . . . . .	26,880
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Asstt. Geologist 1 @ Rs. 500/- p.m. for one year . . . . .	6,000
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Drill Foreman 1 @ Rs. 1,000/-p.m. for one year . . . . .	12,000
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<b>Total</b> . . . . .	<b>44,880</b>
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<b>Carried forward</b> . . . . .	<b>2,81,840</b>
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## 2. Pay of Establishment.

Overseers 8 @ Rs. 240/- p.m. for two years	46,050	
Senior Clerks 2 @ Rs. 150/- p.m. for two years	7,200	
Junior Clerks 2 @ Rs. 93/- p.m. for two years	4,464	
Dafadars 2 @ Rs. 33/- p.m. for two years	1,584	
Gauge Readers 3 @ Rs. 70/- p.m. for two years	5,040	
Peons 4 @ Rs. 33/- p.m. for two years	3,168	
Khalasis 8 @ Rs. 33/- p.m. for two years	6,336	
Chawkidars 2 @ Rs. 33/- p.m. for two years	1,584	
Dak Runners 2 @ Rs. 33/- p.m. for two years	1,584	
<b>Total</b>	<b>77,040</b>	
3. Dearness Allowance of officers	4,800	
4. Dearness Allowance of Establishment	20,000	
<b>Total</b>	<b>24,800</b>	
5. T.A. of Officers	8,000	
6. T.A. of establishment	12,000	
<b>Total</b>	<b>20,000</b>	
<b>Total</b>	<b>1,66,720</b>	
Contingencies @ 2 %	3,320	
<b>Total—Establishment</b>	<b>1,70,040</b>	<b>1,70,040</b>
<b>Grand Total</b>		<b>4,52,000</b>
Estimate for Year	1948-49	1949-50
(Details as under)	2,20,000	2,32,000

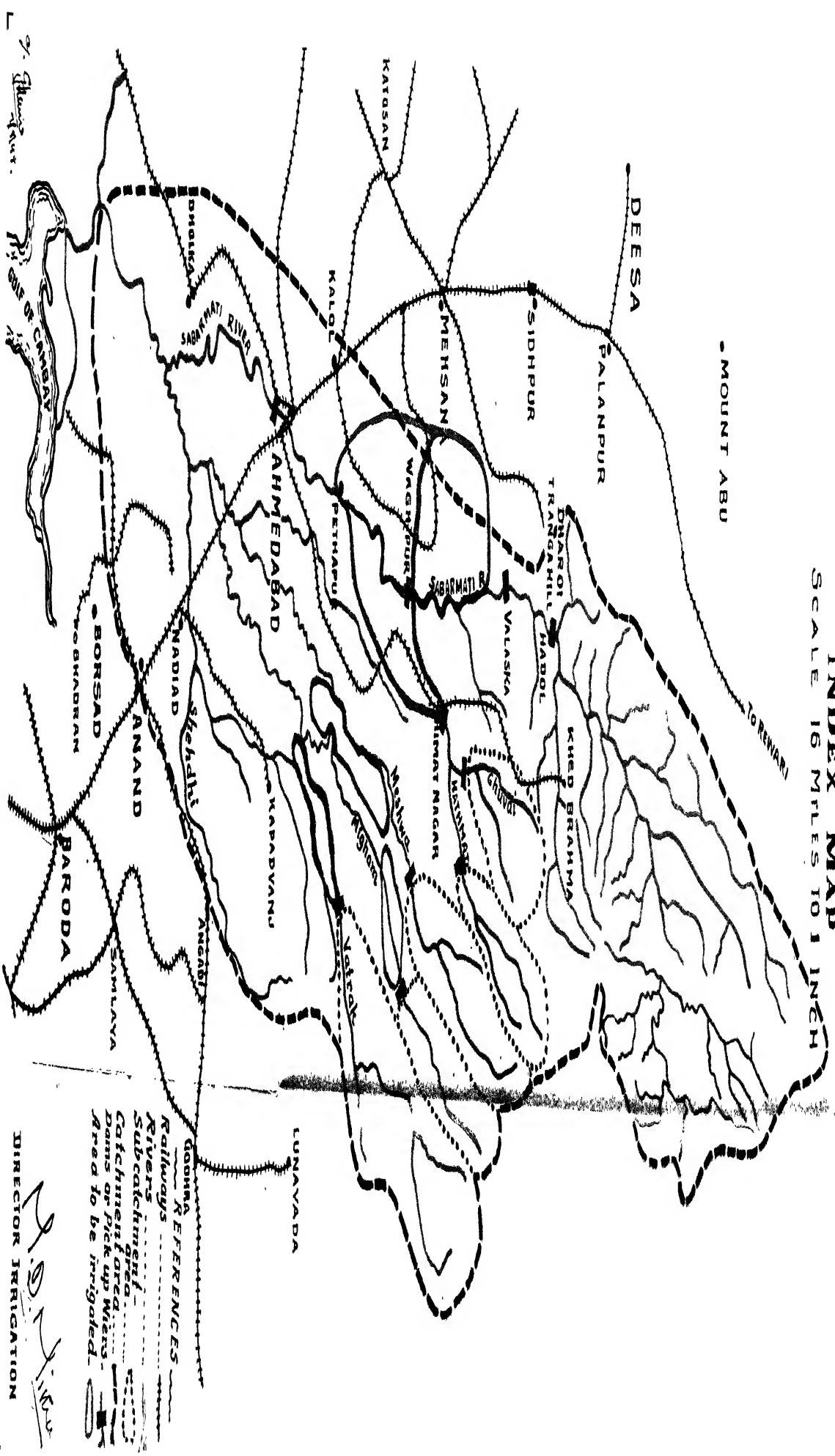
*Estimate for Preliminary investigations of Irrigation and Hydel Projects in Coorg Province for the year 1948-49 and 1949-50.*

	1948-49	1949-50
<b>I. Works—</b>		
(i) <i>Dam and Appurtenant Works.—</i>		
Surveys and investigations :—		
1. Survey of basin reservoir	1,800	1,950
2. Survey of the damsite	2,560	2,560
3. Geological investigations	..	50,000
4. Soil analysis for earthen dam	1,000	1,000
(ii) <i>Buildings.—</i>		
Temporary Buildings	5,000	..
(iii) <i>Main Canals and branches.—</i>		
(a) Survey of the commanded area	5,625	..
(b) Miscellaneous Surveys	..	4,000
(iv) <i>Discharge and silt observations.</i>	15,000	15,000
(v) <i>Meteorological observations</i>	2,000	..
(vi) <i>Electrical load survey</i>	5,000	5,000
(vii) <i>Economic and property surveys</i>	2,500	2,500
(viii) <i>Communications</i>	2,500	2,500
(ix) <i>Special tools and plants.</i>	..	60,000
Testing samples, laboratory etc.	11,000	..
Contingencies	1,495	2,470
	55,480	1,46,980
<b>II. Tools and Plants</b>	79,500	..
<b>III. Establishment</b>	85,020	85,020
<b>Grand Total</b>	<b>2,20,000</b>	<b>2,32,000</b>

M. D. MITTHAL,  
Director (Irrigation & Waterways),  
C. W. I. N. C.



# SABARMATI BASIN INDEX MAP SCALE 16 MILES TO 1 INCH

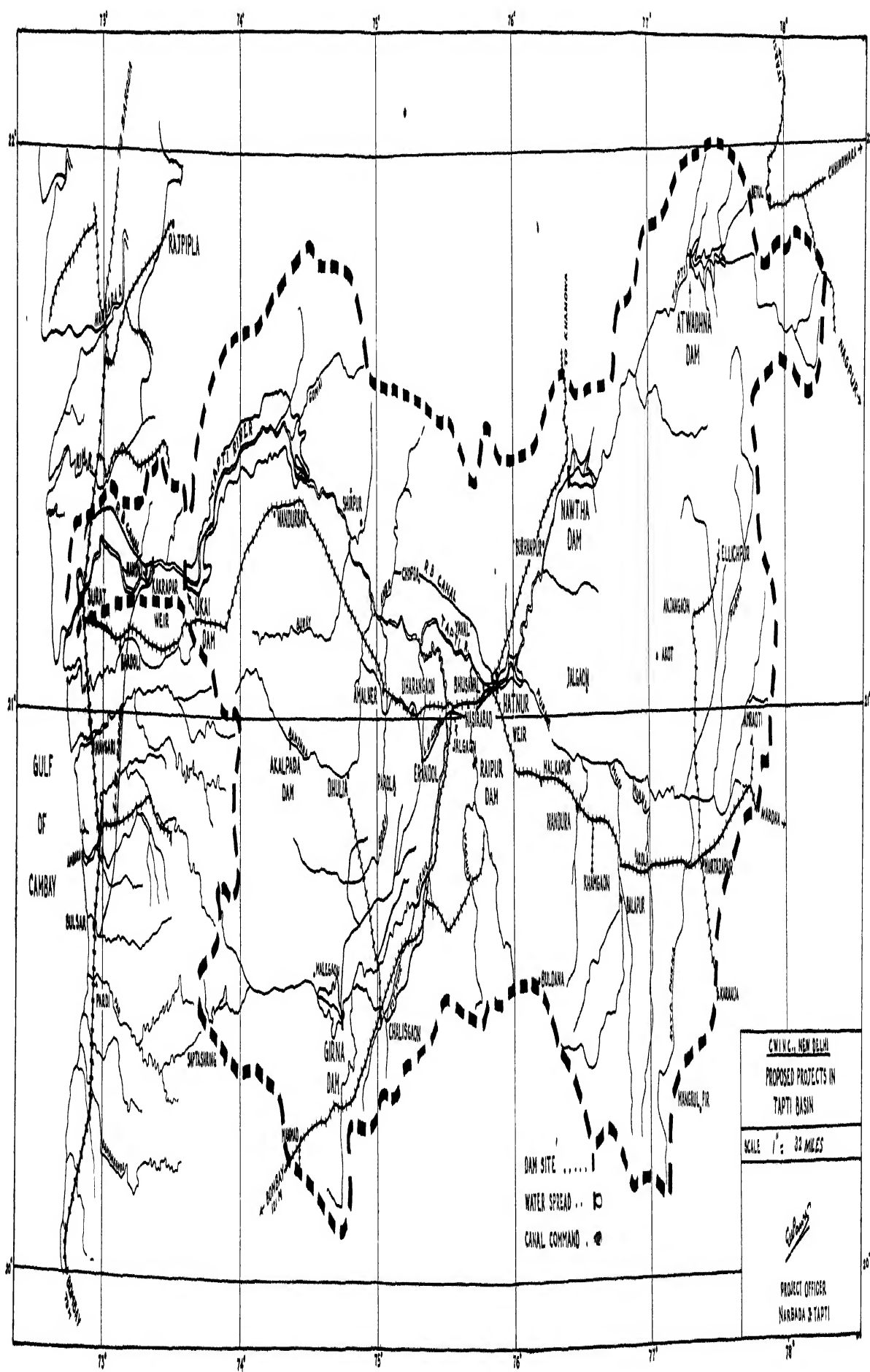


GODHRA  
 REFERENCES  
 Railways  
 Rivers  
 Subcatchment  
 Catchment area  
 Dams or Pick up Weirs  
 Areas to be irrigated

DIRECTOR IRRIGATION  
 12.5.1934

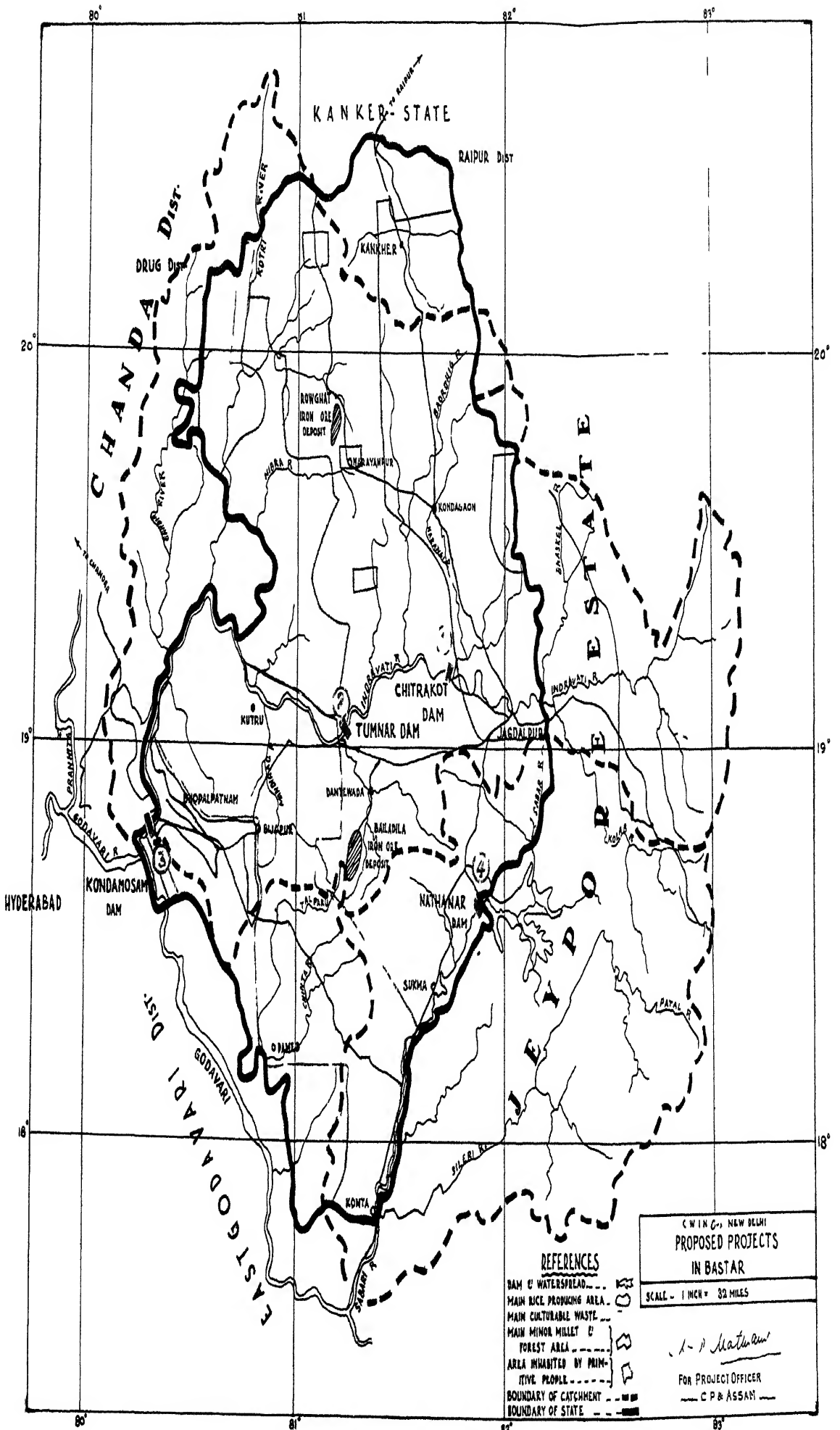
7. Bhambhani  
 14. 3. 34









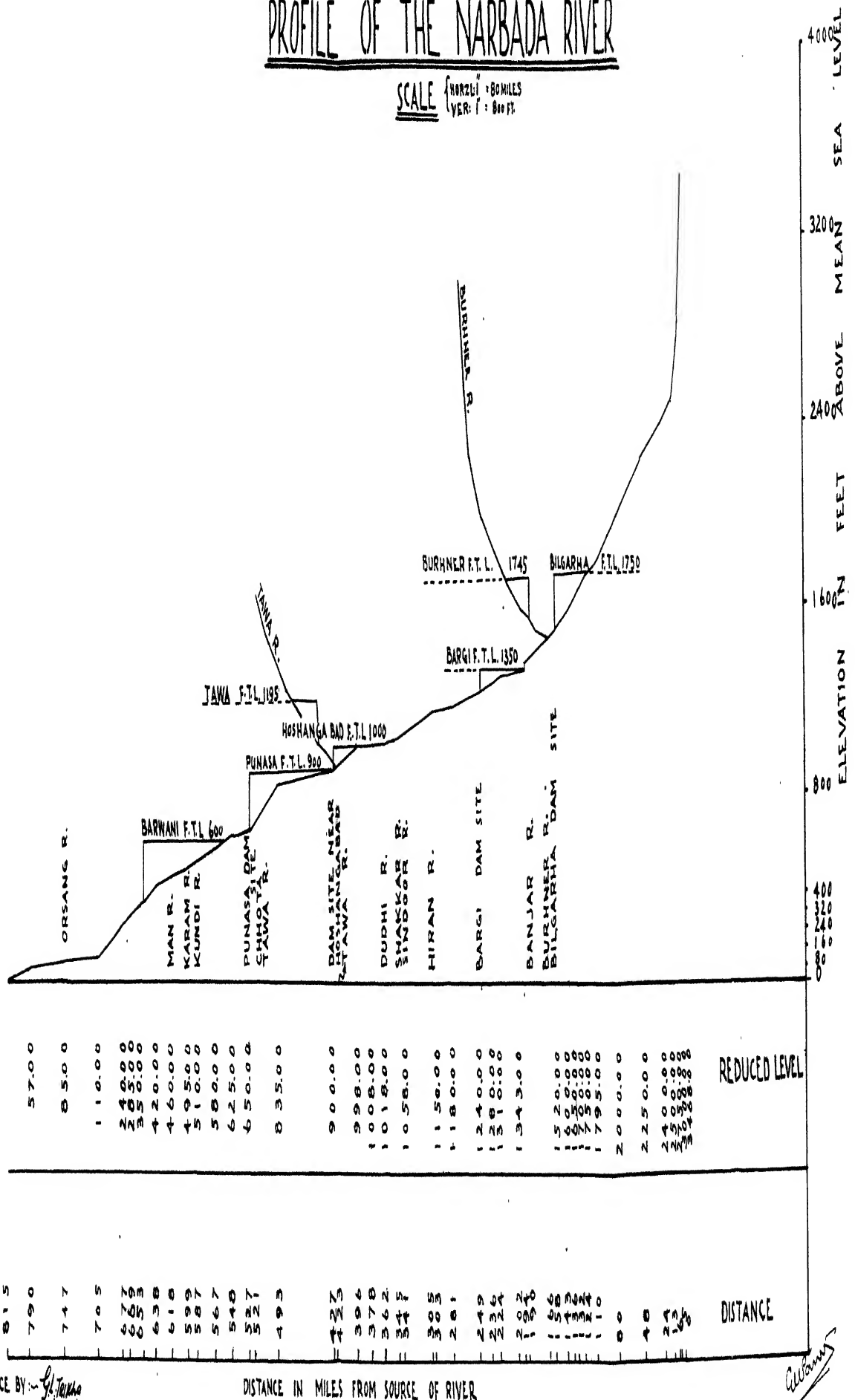






## PROFILE OF THE NARBADA RIVER

SCALE { HORIZ: 1" = 80 MILES  
VER: 1" = 800 FT.



RACE BY: - G. L. TINKER

CHECKED BY: *[Signature]* 22.4.4

DISTANCE IN MILES FROM SOURCE OF RIVER

P.O. (NARBADA & TAPTI)



INDEX PLAN OF COORG

SCALE 1/3 MILES

■ SOMVARPET

HERANGI  
DAM

■ MEGARA

TIRARAJENDRAPET

BARADOLE

BARADOLE  
PROJECT

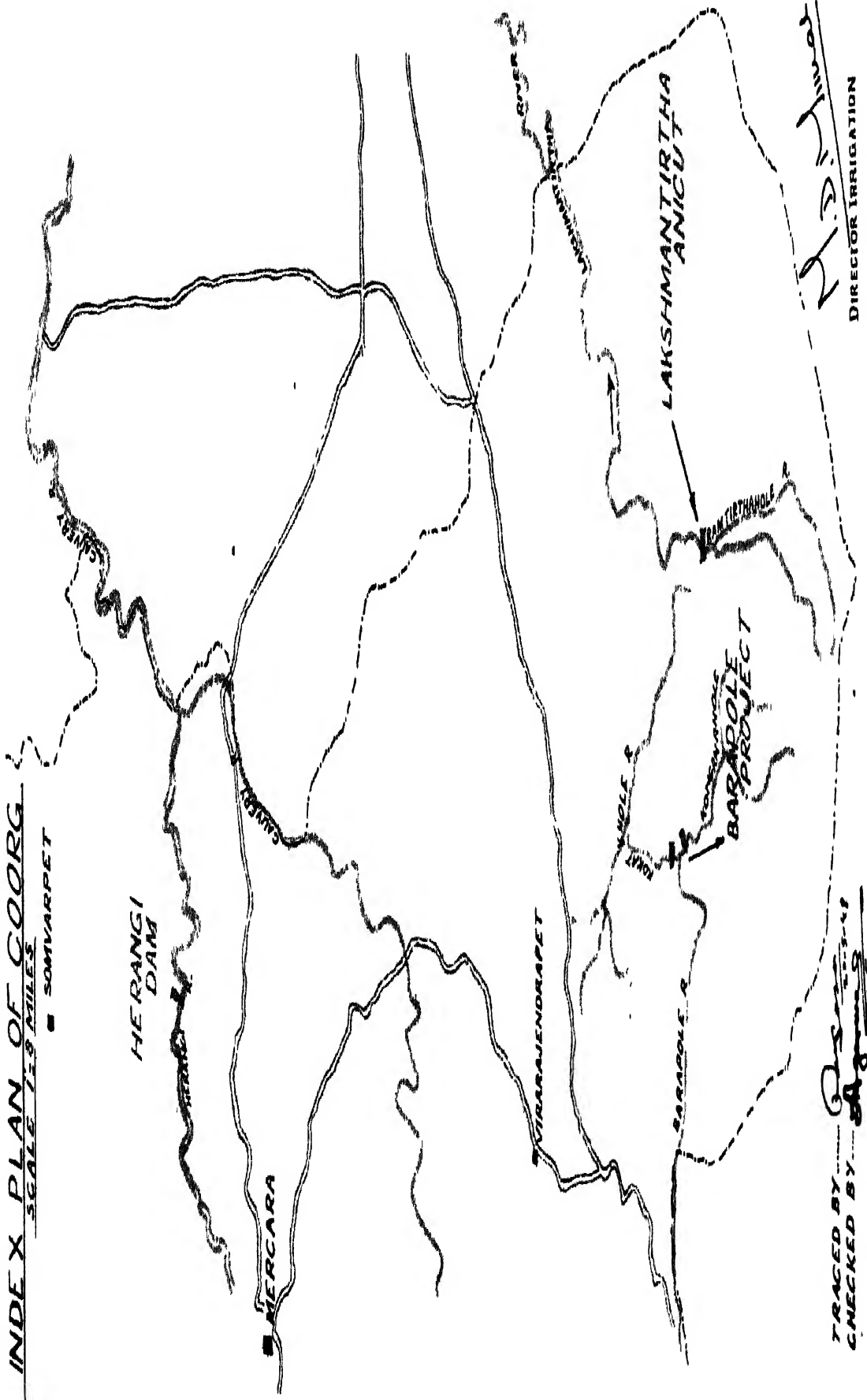
WHOLE R.

GRANTIECHAHOLE

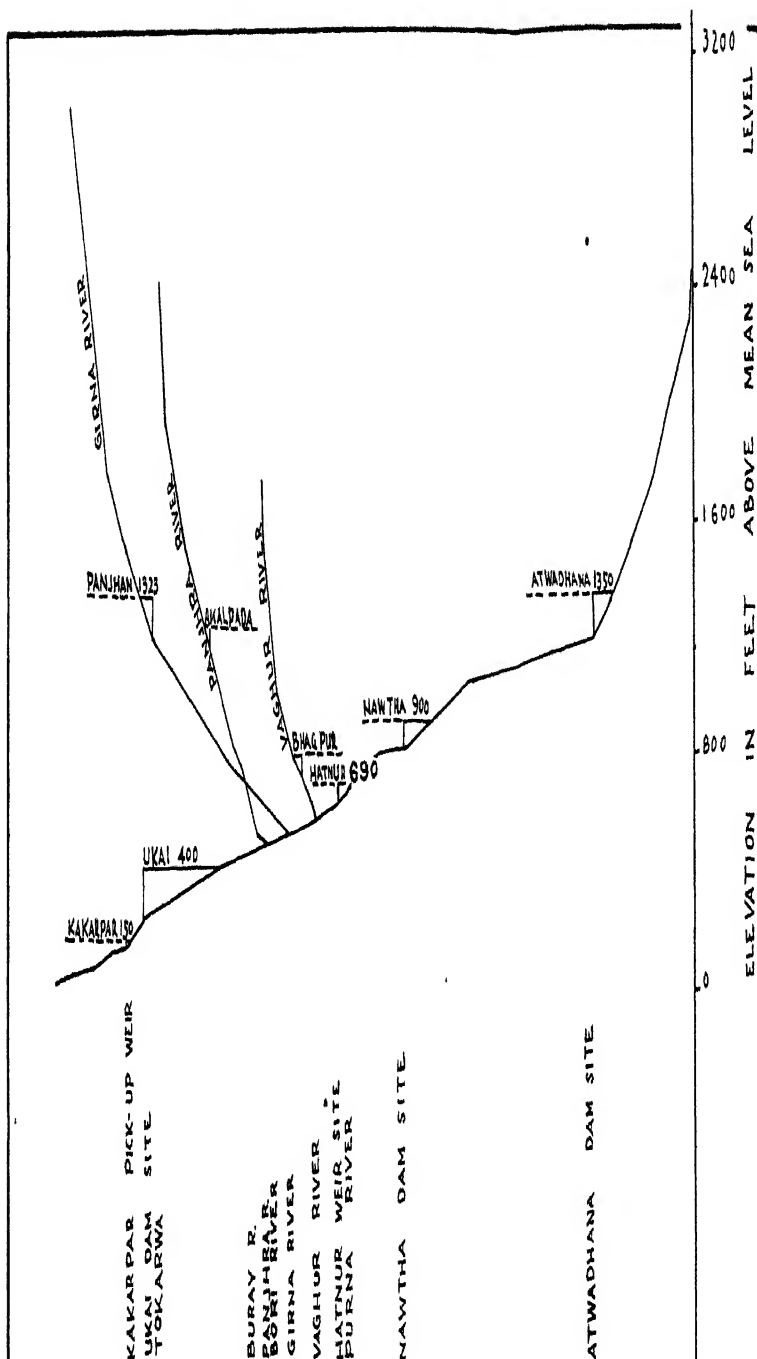
LAKSHMIANTIRTHA  
ANICUT

TRACED BY P. S. S. S. S.  
CHECKED BY P. S. S. S. S.

P. S. S. S. S.  
DIRECTOR IRRIGATION







REDUCED LEVEL	DISTANCE IN MILES FROM SOURCE OF RIVER
2100	5.52
1700	5.30
1500	5.16
1300	5.02
1100	4.87
900	4.78
700	4.20
500	3.94
300	3.76
100	3.60
0	3.42
100	3.25
200	3.08
300	2.92
400	2.79
500	2.60
600	2.40
700	2.20
800	2.00
900	1.80
1000	1.60
1100	1.40
1200	1.20
1300	1.00
1400	0.80
1500	0.60
1600	0.40
1700	0.20
1800	0.00

C.M.I.N.C. NEW DELHI.

# PROFILE OF THE TAPI RIVER

SCALE :- { 1" HORZL = 100 MILES  
1" VER = 1000 FT

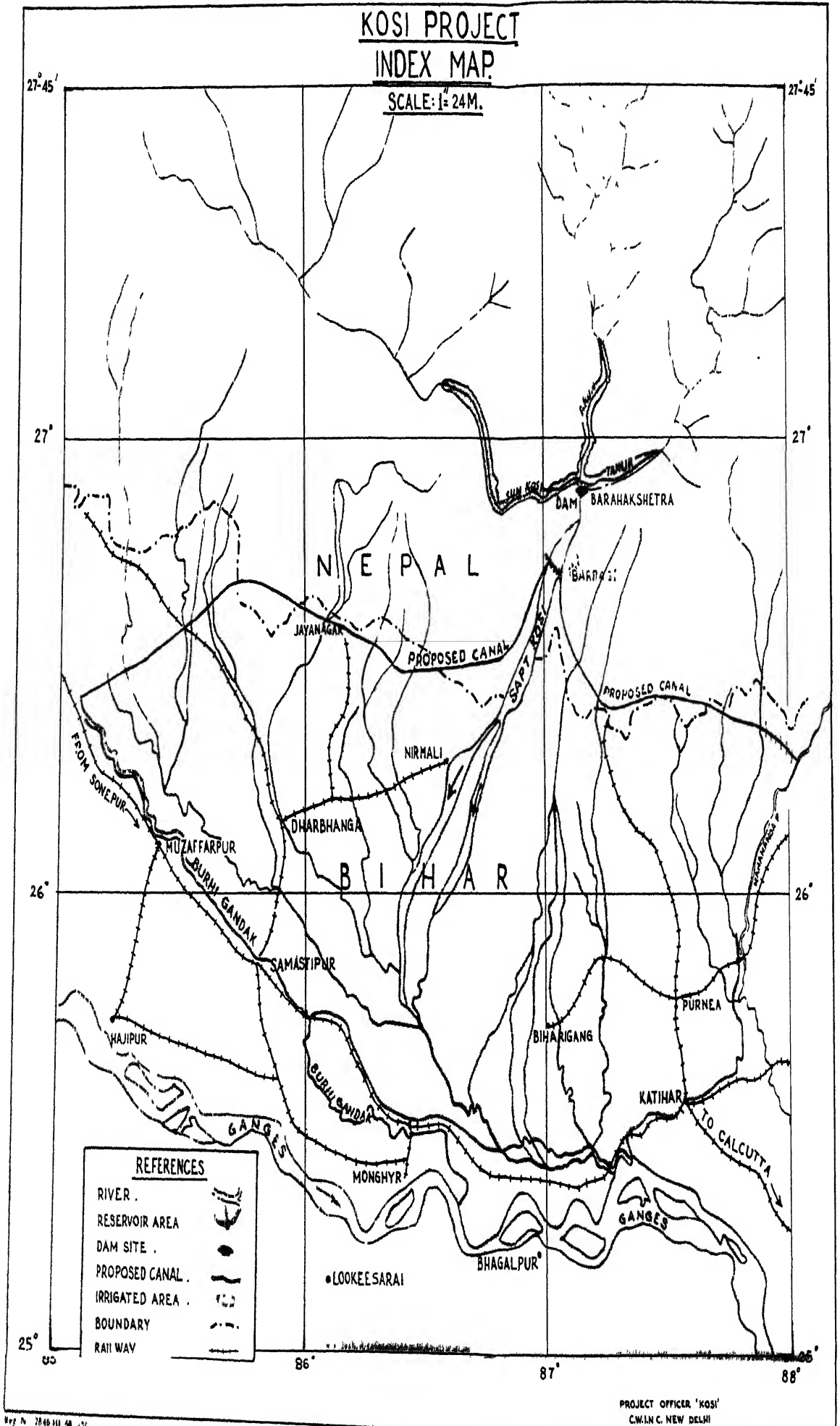
*G. B. Singh*

PROJECT OFFICER  
NARBADA & TAPI.



# KOSI PROJECT INDEX MAP.

SCALE: 1"=24M.



PROJECT OFFICER 'KOSI'  
C.W.M. IN C. NEW DELHI





INDEX MAP OF ASSAM

SHOWING  
PROPOSED DAM SITES

SCALE 1"=32 MILES

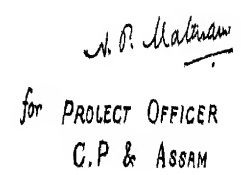
*P. A. Assam*  
FOR PROJECT OFFICER—  
P & A, ASSAM

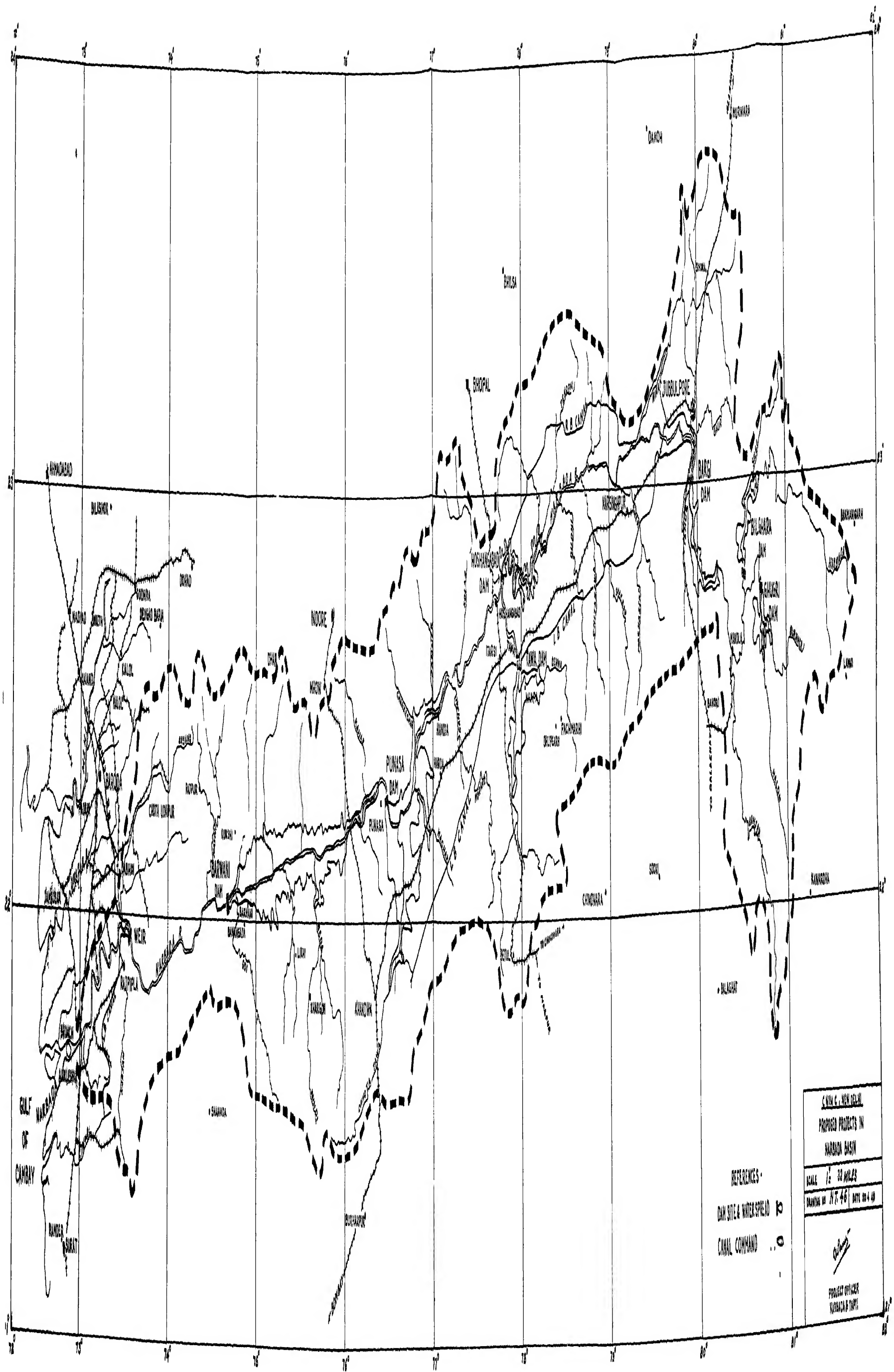




SHOWING

SCALE 1=32 MILES





REFERENCES -  
 DAM SITE & WATER SPREAD  
 CANAL COMMAND

C. N. C. - NEW DELHI	
PROPOSED PROJECTS IN NARMADA BASIN	
SCALE	1" = 30 MILES
DRAWING BY	DATE
PROJECT OFFICER NARMADA BASIN	





**PRESIDENT'S  
SECRETARIAT  
LIBRARY**